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Huang et al.

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(54) **TELECOMMUNICATIONS SWITCH MANAGEMENT SYSTEM**

(75) Inventors: **Peter Sung-An Huang; Dwight W. Doss**, both of Richardson, TX (US)

(73) Assignee: **Alcatel USA Sourcing, L.P.**, Plano, TX (US)

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(22) Filed: **Dec. 23, 1997**

(51) **Int. Cl.**[7] **G06F 15/173**

(52) **U.S. Cl.** **709/223**; 709/224; 709/226; 709/315

(58) **Field of Search** 709/223, 224, 709/225, 226, 315, 316

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Primary Examiner—Robert B. Harrell
Assistant Examiner—William C. Vaughn, Jr.
(74) *Attorney, Agent, or Firm*—Baker Botts L.L.P.

(57) **ABSTRACT**

A telecommunications switch management system which contains a system manager building block in communication with a remote computer. The system manager building block is also in communication with a system management interface building block, which contains a command interpreter building block and a system command interface building block. The command interpreter building block is in communication with the system manager building block and the system command interface building block. The system command interface building block contains at least one client building block. The client building blocks located in the system command interface building block are each in communication with a corresponding server building block, each of which in turn is in communication with the telecommunications switching system. The system manager building block provides communication between the remote computer and the system management interface building block. The system management interface building block provides communication between the system manager building block and the one or more servers which are in communication with the telecommunications switching system.

17 Claims, 13 Drawing Sheets

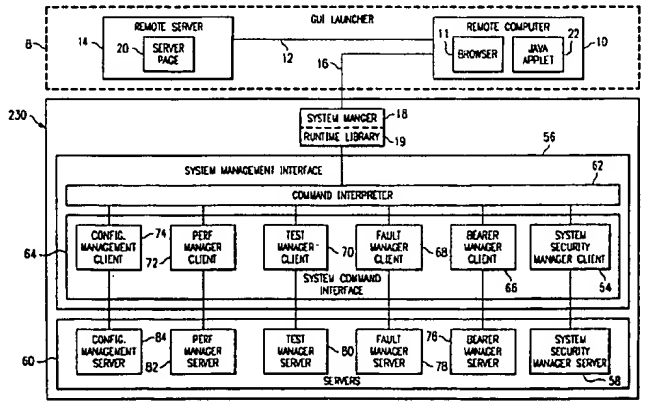


FIG. 1

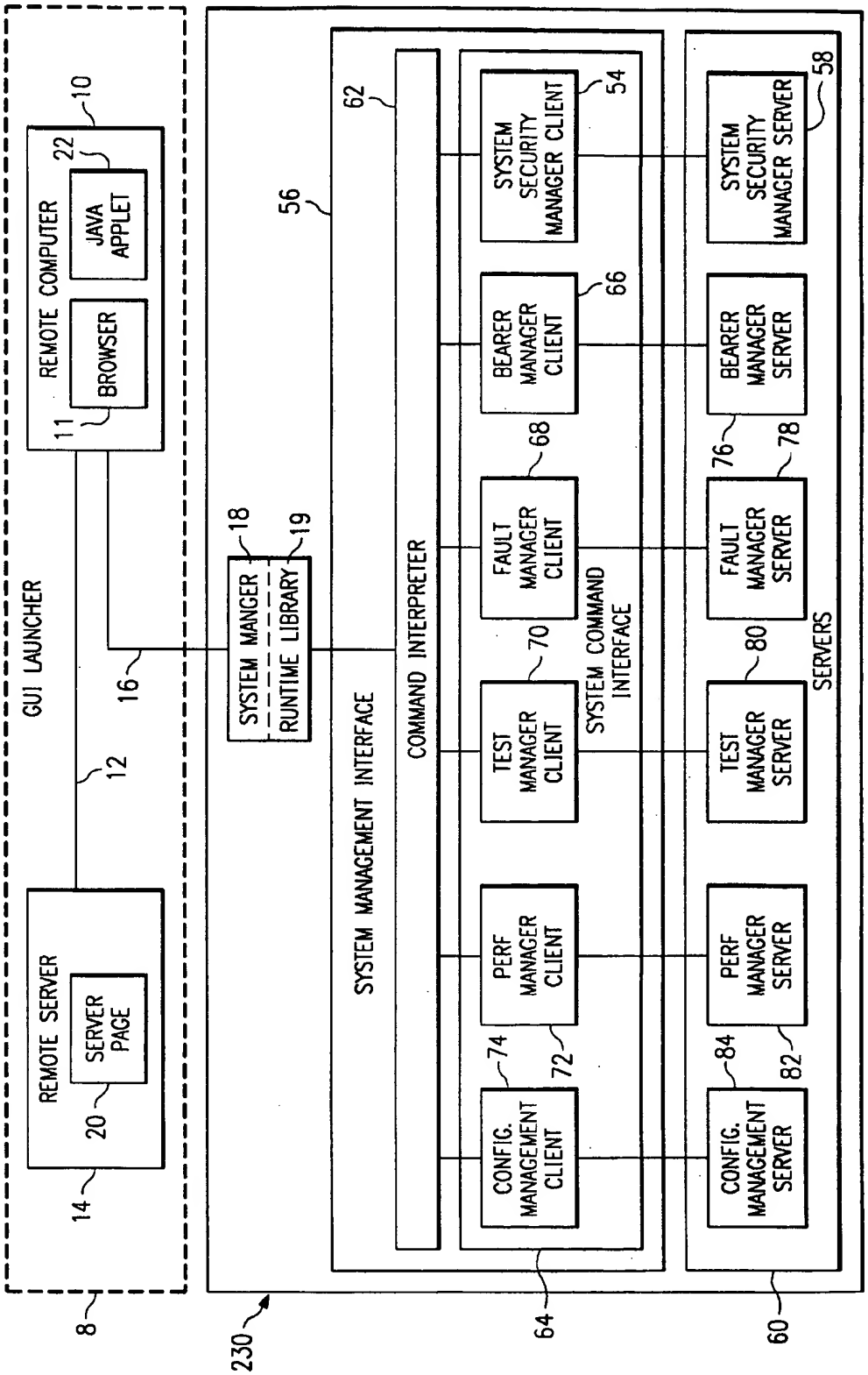

GUI LAUNCHER
REMOTE COMPUTER
BROWSER
JAVA APPLET
REMOTE SERVER
SERVER PAGE
SYSTEM MANGER
RUNTIME LIBRARY
SYSTEM MANAGEMENT INTERFACE
COMMAND INTERPRETER
SYSTEM COMMAND INTERFACE
SYSTEM SECURITY MANAGER CLIENT
BEARER MANAGER CLIENT
FAULT MANAGER CLIENT
TEST MANAGER CLIENT
PERF MANAGER CLIENT
CONFIG. MANAGEMENT CLIENT
SYSTEM SECURITY MANAGER SERVER
BEARER MANAGER SERVER
FAULT MANAGER SERVER
TEST MANAGER SERVER
PERF MANAGER SERVER
CONFIG. MANAGEMENT SERVER
SERVERS
8
10
11
12
14
16
18
19
20
22
54
56
58
60
62
64
66
68
70
72
74
76
78
80
82
84
230

FIG. 2

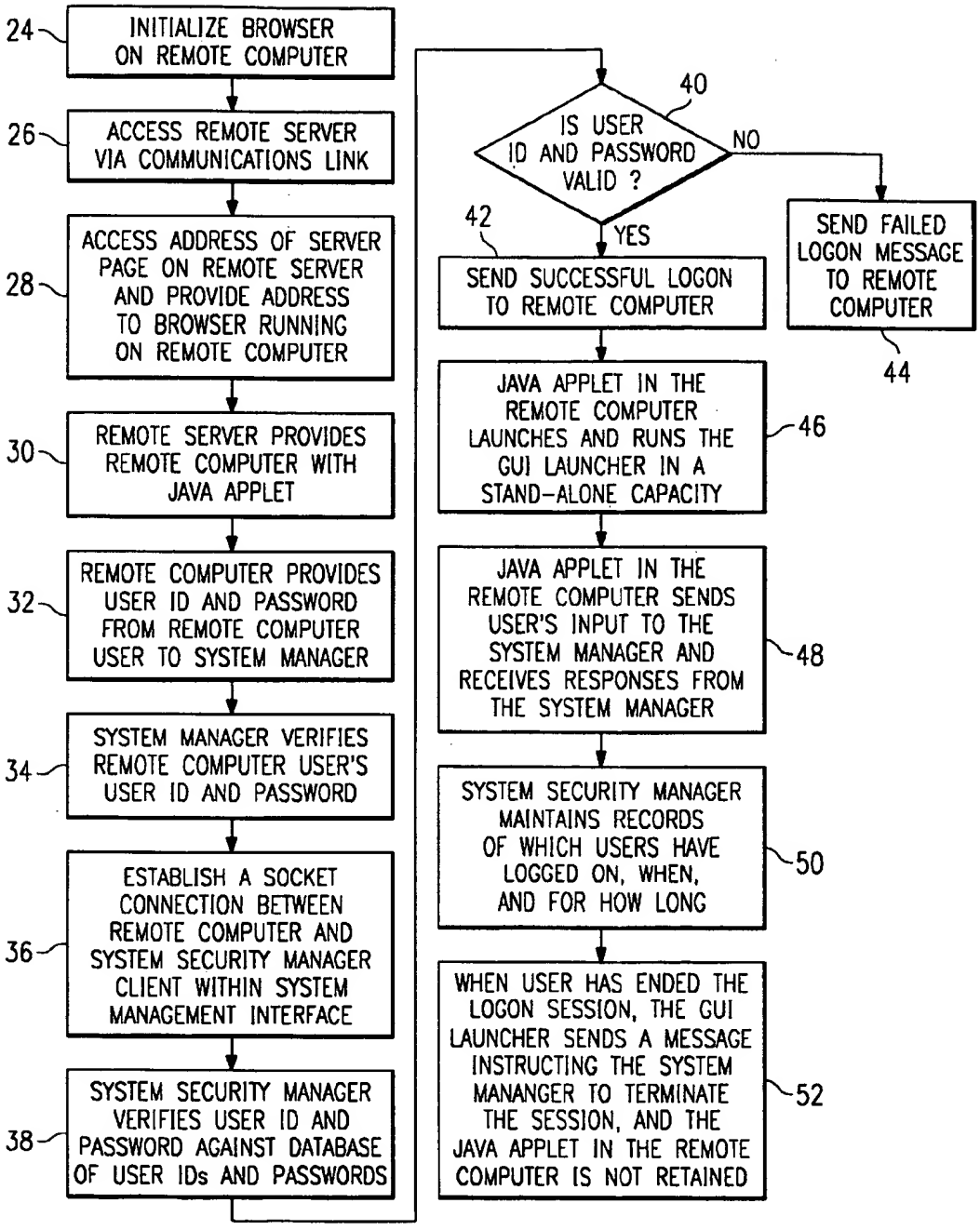
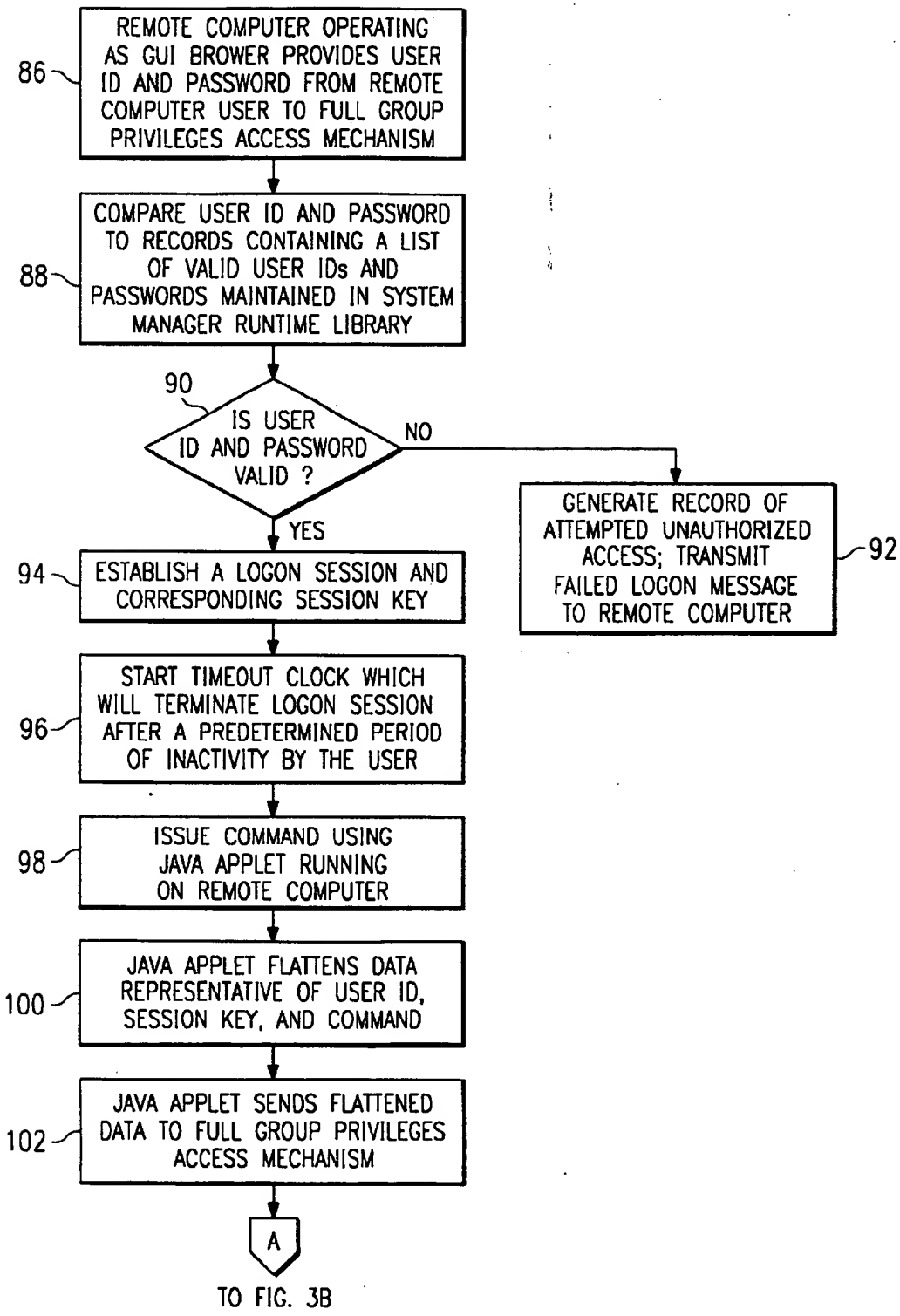

24
INITIALIZE BROWSER ON REMOTE COMPUTER
26
ACCESS REMOTE SERVER VIA COMMUNICATIONS LINK
28
ACCESS ADDRESS OF SERVER PAGE ON REMOTE SERVER AND PROVIDE ADDRESS TO BROWSER RUNNING ON REMOTE COMPUTER
30
REMOTE SERVER PROVIDES REMOTE COMPUTER WITH JAVA APPLET
32
REMOTE COMPUTER PROVIDES USER ID AND PASSWORD FROM REMOTE COMPUTER USER TO SYSTEM MANAGER
34
SYSTEM MANAGER VERIFIES REMOTE COMPUTER USER'S USER ID AND PASSWORD
36
ESTABLISH A SOCKET CONNECTION BETWEEN REMOTE COMPUTER AND SYSTEM SECURITY MANAGER CLIENT WITHIN SYSTEM MANAGEMENT INTERFACE
38
SYSTEM SECURITY MANAGER VERIFIES USER ID AND PASSWORD AGAINST DATABASE OF USER IDs AND PASSWORDS
40
IS USER ID AND PASSWORD VALID ?
NO
YES
42
SEND SUCCESSFUL LOGON TO REMOTE COMPUTER
SEND FAILED LOGON MESSAGE TO REMOTE COMPUTER
44
JAVA APPLET IN THE REMOTE COMPUTER LAUNCHES AND RUNS THE GUI LAUNCHER IN A STAND-ALONE CAPACITY
46
JAVA APPLET IN THE REMOTE COMPUTER SENDS USER'S INPUT TO THE SYSTEM MANAGER AND RECEIVES RESPONSES FROM THE SYSTEM MANAGER
48
SYSTEM SECURITY MANAGER MAINTAINS RECORDS OF WHICH USERS HAVE LOGGED ON, WHEN, AND FOR HOW LONG
50
WHEN USER HAS ENDED THE LOGON SESSION, THE GUI LAUNCHER SENDS A MESSAGE INSTRUCTING THE SYSTEM MANANGER TO TERMINATE THE SESSION, AND THE JAVA APPLET IN THE REMOTE COMPUTER IS NOT RETAINED
52

FIG. 3A


86
REMOTE COMPUTER OPERATING AS GUI BROWER PROVIDES USER ID AND PASSWORD FROM REMOTE COMPUTER USER TO FULL GROUP PRIVILEGES ACCESS MECHANISM
88
COMPARE USER ID AND PASSWORD TO RECORDS CONTAINING A LIST OF VALID USER IDs AND PASSWORDS MAINTAINED IN SYSTEM MANAGER RUNTIME LIBRARY
90
IS USER ID AND PASSWORD VALID ?
NO
YES
GENERATE RECORD OF ATTEMPTED UNAUTHORIZED ACCESS; TRANSMIT FAILED LOGON MESSAGE TO REMOTE COMPUTER
92
94
ESTABLISH A LOGON SESSION AND CORRESPONDING SESSION KEY
96
START TIMEOUT CLOCK WHICH WILL TERMINATE LOGON SESSION AFTER A PREDETERMINED PERIOD OF INACTIVITY BY THE USER
98
ISSUE COMMAND USING JAVA APPLET RUNNING ON REMOTE COMPUTER
100
JAVA APPLET FLATTENS DATA REPRESENTATIVE OF USER ID, SESSION KEY, AND COMMAND
102
JAVA APPLET SENDS FLATTENED DATA TO FULL GROUP PRIVILEGES ACCESS MECHANISM
A
TO FIG. 3B

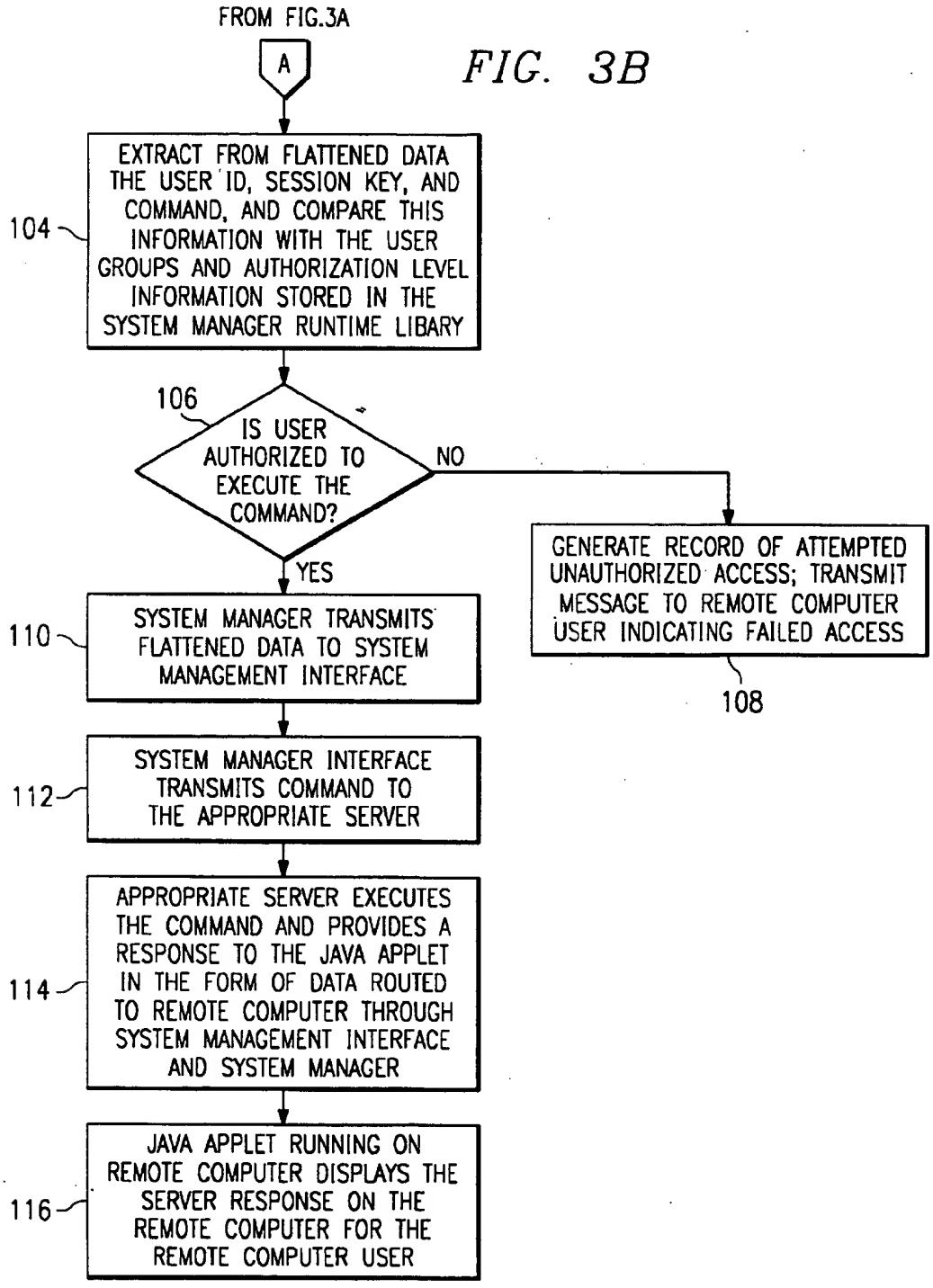

FROM FIG.3A
A
104
EXTRACT FROM FLATTENED DATA THE USER ID, SESSION KEY, AND COMMAND, AND COMPARE THIS INFORMATION WITH THE USER GROUPS AND AUTHORIZATION LEVEL INFORMATION STORED IN THE SYSTEM MANAGER RUNTIME LIBARY
106
IS USER AUTHORIZED TO EXECUTE THE COMMAND?
NO
YES
GENERATE RECORD OF ATTEMPTED UNAUTHORIZED ACCESS; TRANSMIT MESSAGE TO REMOTE COMPUTER USER INDICATING FAILED ACCESS
108
110
SYSTEM MANAGER TRANSMITS FLATTENED DATA TO SYSTEM MANAGEMENT INTERFACE
112
SYSTEM MANAGER INTERFACE TRANSMITS COMMAND TO THE APPROPRIATE SERVER
114
APPROPRIATE SERVER EXECUTES THE COMMAND AND PROVIDES A RESPONSE TO THE JAVA APPLET IN THE FORM OF DATA ROUTED TO REMOTE COMPUTER THROUGH SYSTEM MANAGEMENT INTERFACE AND SYSTEM MANAGER
116
JAVA APPLET RUNNING ON REMOTE COMPUTER DISPLAYS THE SERVER RESPONSE ON THE REMOTE COMPUTER FOR THE REMOTE COMPUTER USER

FIG. 3B

FIG. 4

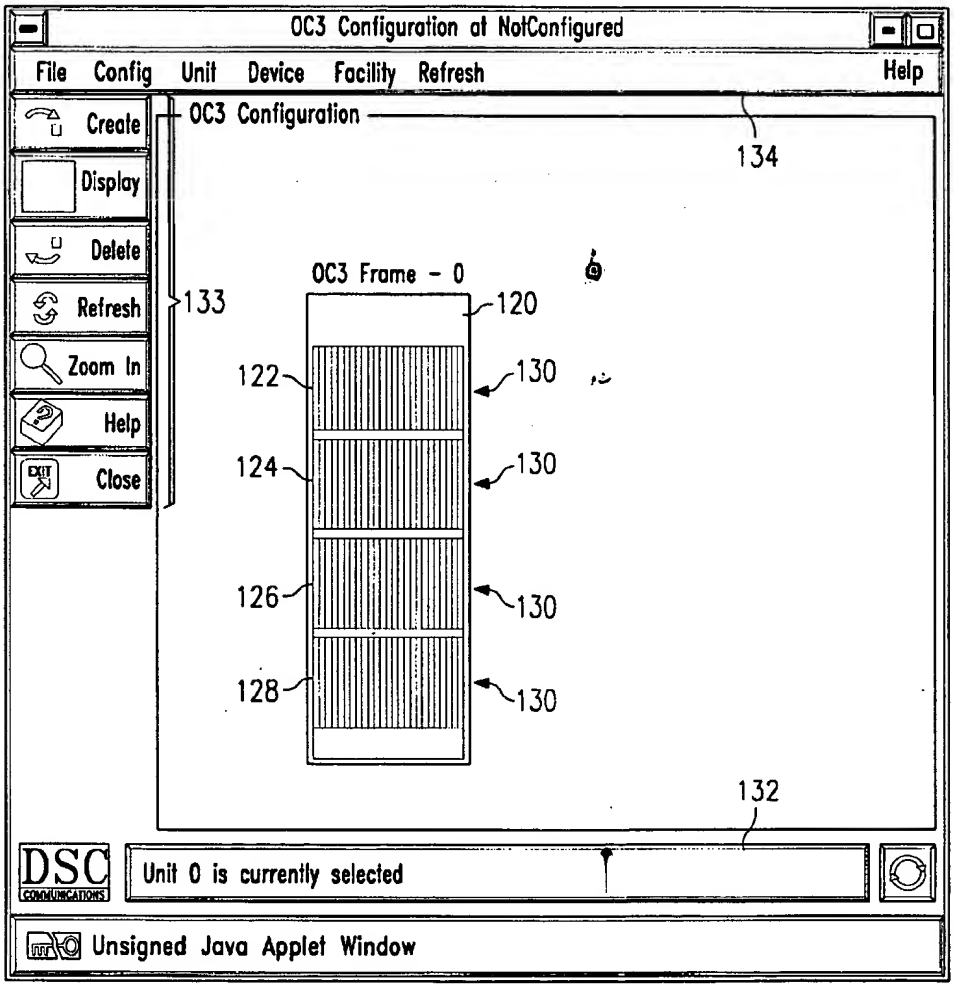

OC3 Configuration at NotConfigured
File
Config
Unit
Device
Facility
Refresh
Help
Create
Display
Delete
Refresh
Zoom In
Help
Close
OC3 Configuration
134
OC3 Frame - 0
133
120
122
130
124
130
126
130
128
130
132
DSC
COMMUNICATIONS
Unit 0 is currently selected
Unsigned Java Applet Window

FIG. 5

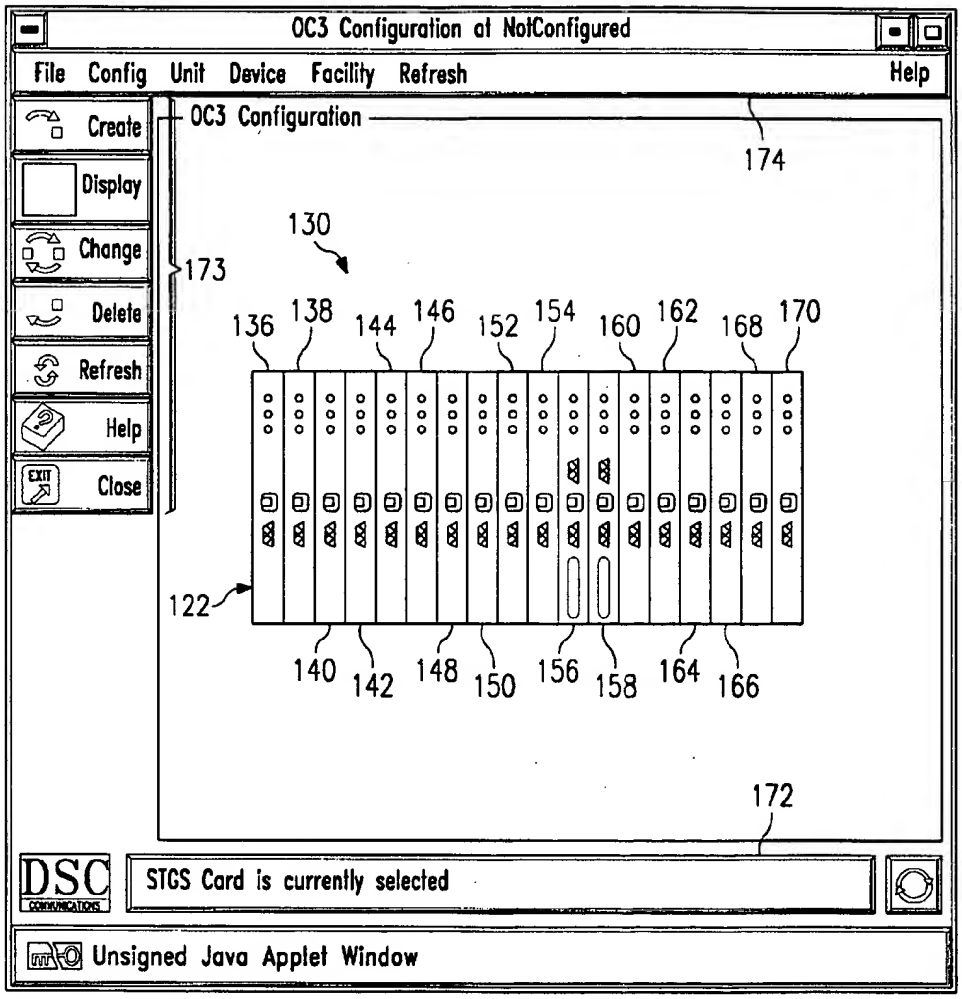

OC3 Configuration at NotConfigured
File Config Unit Device Facility Refresh Help
Create
Display
Change
Delete
Refresh
Help
Close
OC3 Configuration
174
130
173
136 138 144 146 152 154 160 162 168 170
122
140 142 148 150 156 158 164 166
172
DSC
STGS Card is currently selected
Unsigned Java Applet Window

FIG. 6

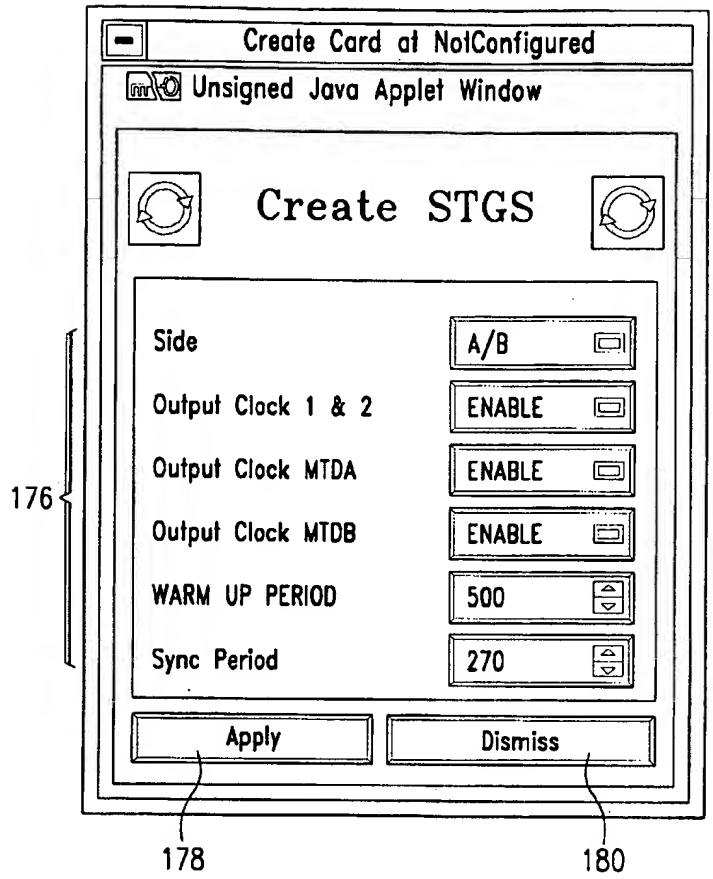

Create Card at NotConfigured
Unsigned Java Applet Window
Create STGS
Side
A/B
Output Clock 1 & 2
ENABLE
Output Clock MTDA
ENABLE
Output Clock MTDB
ENABLE
WARM UP PERIOD
500
Sync Period
270
Apply
Dismiss
176
178
180

FIG. 14

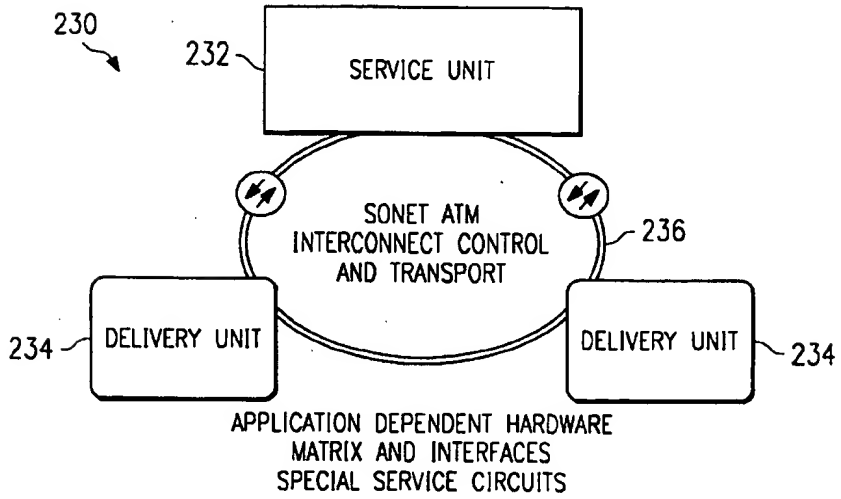

230
232
SERVICE UNIT
SONET ATM
INTERCONNECT CONTROL
AND TRANSPORT
236
234
DELIVERY UNIT
DELIVERY UNIT
234
APPLICATION DEPENDENT HARDWARE
MATRIX AND INTERFACES
SPECIAL SERVICE CIRCUITS

FIG. 7

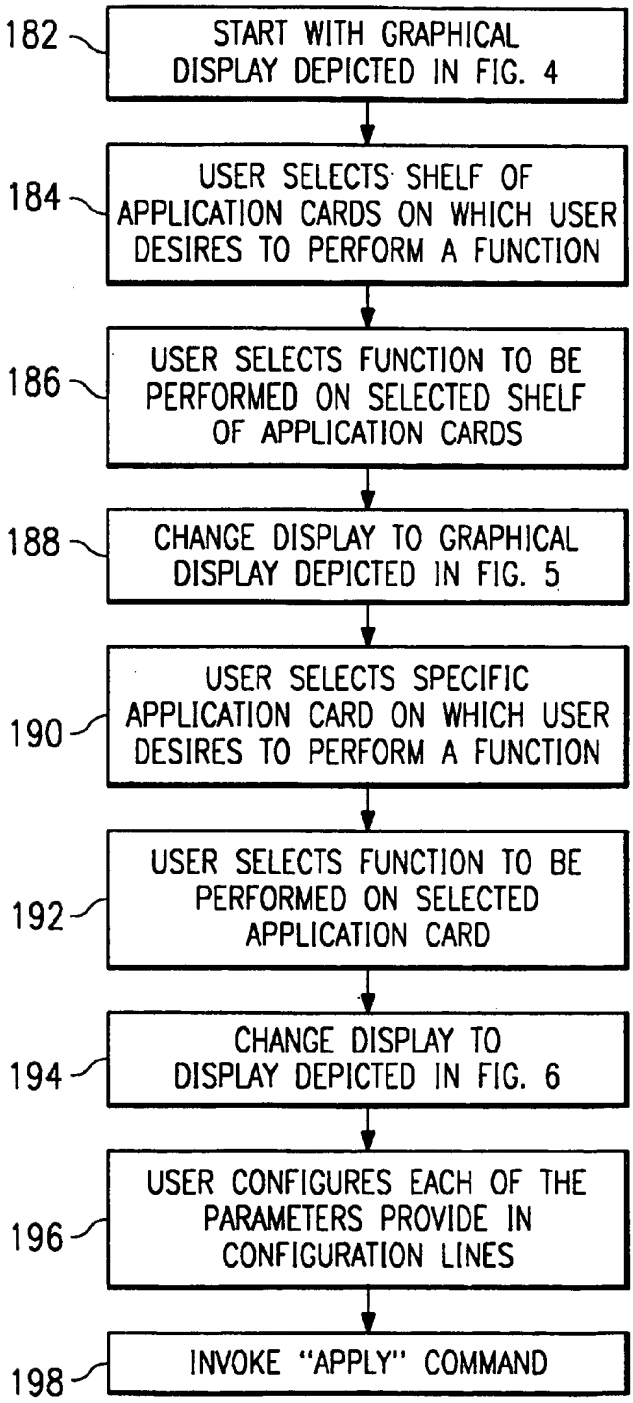

182
START WITH GRAPHICAL DISPLAY DEPICTED IN FIG. 4
184
USER SELECTS SHELF OF APPLICATION CARDS ON WHICH USER DESIRES TO PERFORM A FUNCTION
186
USER SELECTS FUNCTION TO BE PERFORMED ON SELECTED SHELF OF APPLICATION CARDS
188
CHANGE DISPLAY TO GRAPHICAL DISPLAY DEPICTED IN FIG. 5
190
USER SELECTS SPECIFIC APPLICATION CARD ON WHICH USER DESIRES TO PERFORM A FUNCTION
192
USER SELECTS FUNCTION TO BE PERFORMED ON SELECTED APPLICATION CARD
194
CHANGE DISPLAY TO DISPLAY DEPICTED IN FIG. 6
196
USER CONFIGURES EACH OF THE PARAMETERS PROVIDE IN CONFIGURATION LINES
198
INVOKE "APPLY" COMMAND

FIG. 8

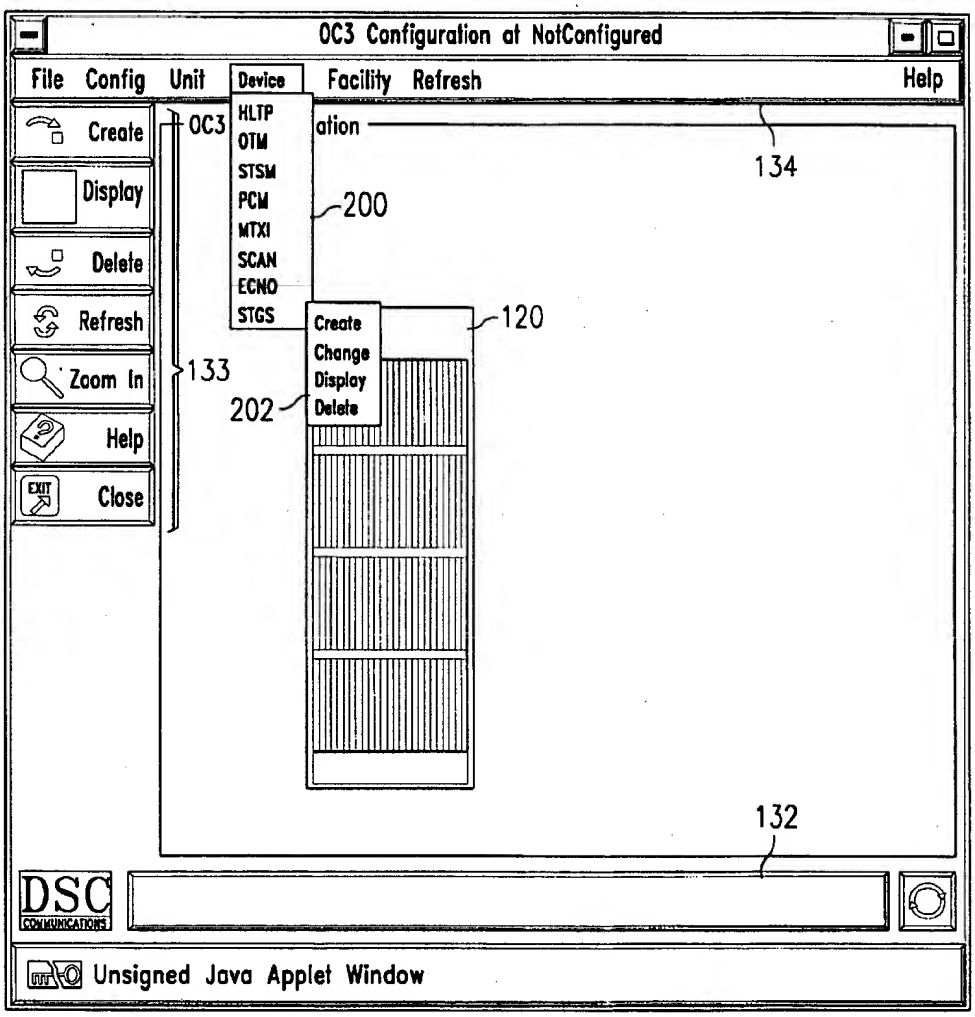

OC3 Configuration at NotConfigured
File
Config
Unit
Device
Facility
Refresh
Help
Create
Display
Delete
Refresh
Zoom In
Help
Close
EXIT
OC3
HLTP
OTM
STSM
PCM
MTXI
SCAN
ECNO
STGS
ation
134
200
120
Create
Change
Display
Delete
133
202
132
DSC
COMMUNICATIONS
Unsigned Java Applet Window

FIG. 9

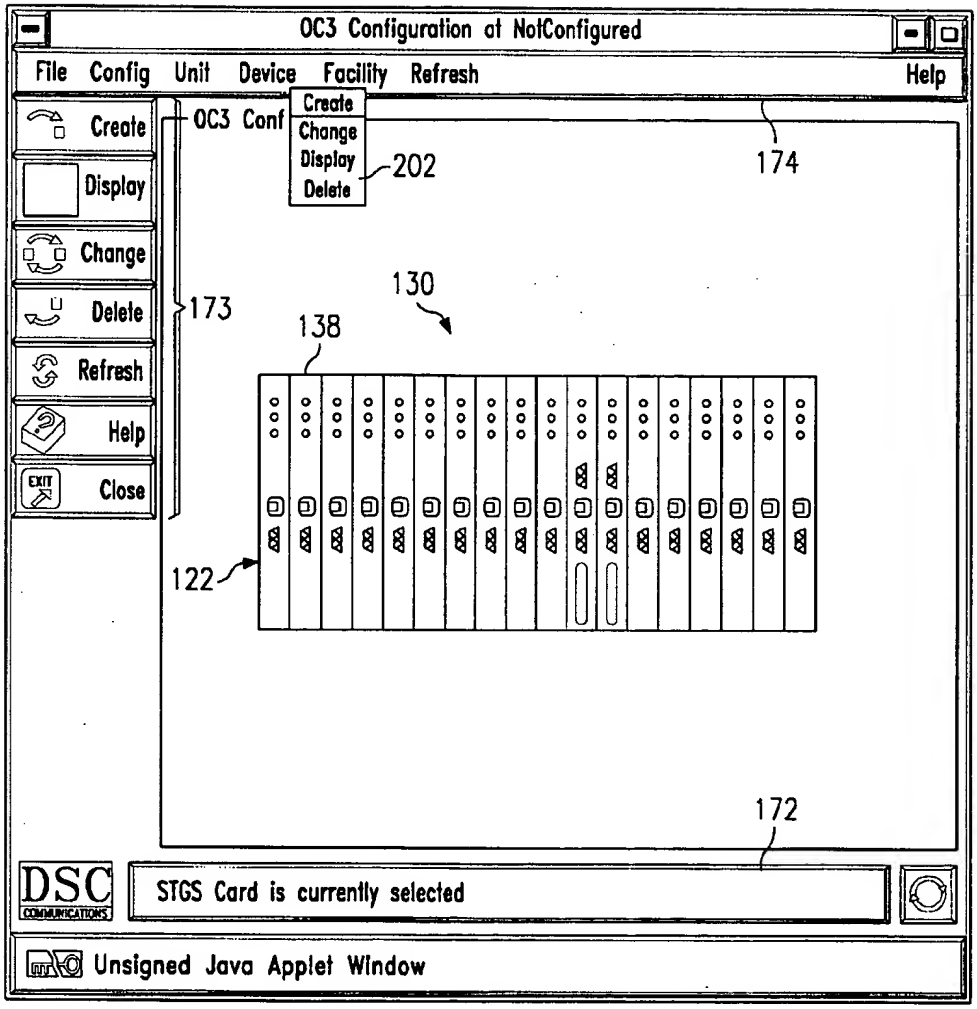

OC3 Configuration at NotConfigured
File
Config
Unit
Device
Facility
Refresh
Help
Create
Change
Display
Delete
OC3 Conf
202
174
Create
Display
Change
Delete
Refresh
Help
Close
173
130
138
122
172
DSC
COMMUNICATIONS
STGS Card is currently selected
Unsigned Java Applet Window

FIG. 10

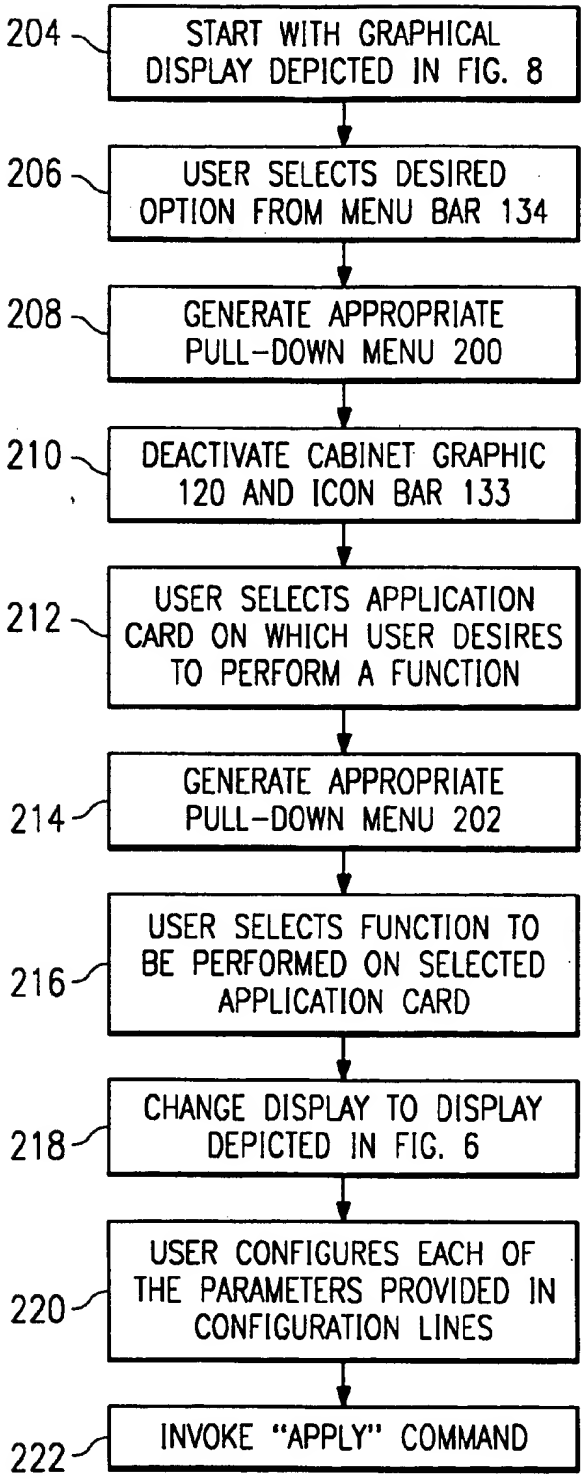

204
START WITH GRAPHICAL DISPLAY DEPICTED IN FIG. 8
206
USER SELECTS DESIRED OPTION FROM MENU BAR 134
208
GENERATE APPROPRIATE PULL-DOWN MENU 200
210
DEACTIVATE CABINET GRAPHIC 120 AND ICON BAR 133
212
USER SELECTS APPLICATION CARD ON WHICH USER DESIRES TO PERFORM A FUNCTION
214
GENERATE APPROPRIATE PULL-DOWN MENU 202
216
USER SELECTS FUNCTION TO BE PERFORMED ON SELECTED APPLICATION CARD
218
CHANGE DISPLAY TO DISPLAY DEPICTED IN FIG. 6
220
USER CONFIGURES EACH OF THE PARAMETERS PROVIDED IN CONFIGURATION LINES
222
INVOKE "APPLY" COMMAND

FIG. 11

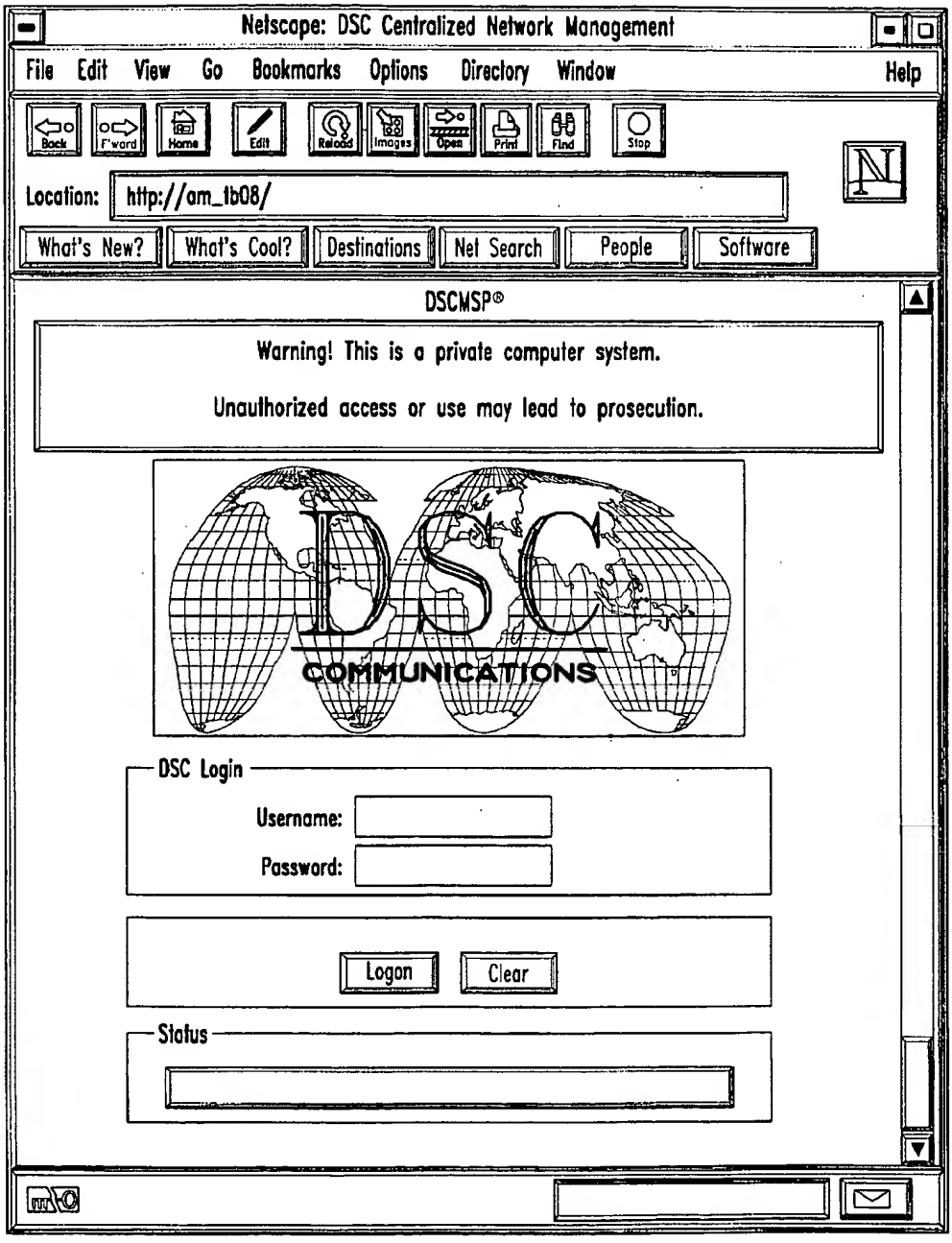

Netscape: DSC Centralized Network Management
File Edit View Go Bookmarks Options Directory Window Help
Back F'word Home Edit Reload Images Open Print Find Stop
Location: http://am_tb08/
What's New? What's Cool? Destinations Net Search People Software
DSCMSP®
Warning! This is a private computer system.
Unauthorized access or use may lead to prosecution.
DSC
COMMUNICATIONS
DSC Login
Username:
Password:
Logon
Clear
Status

FIG. 12

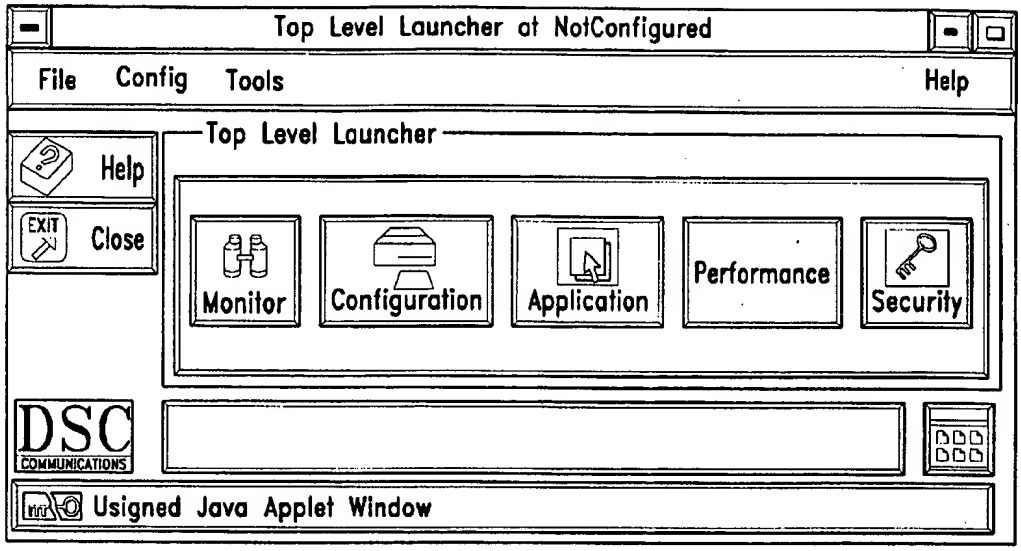
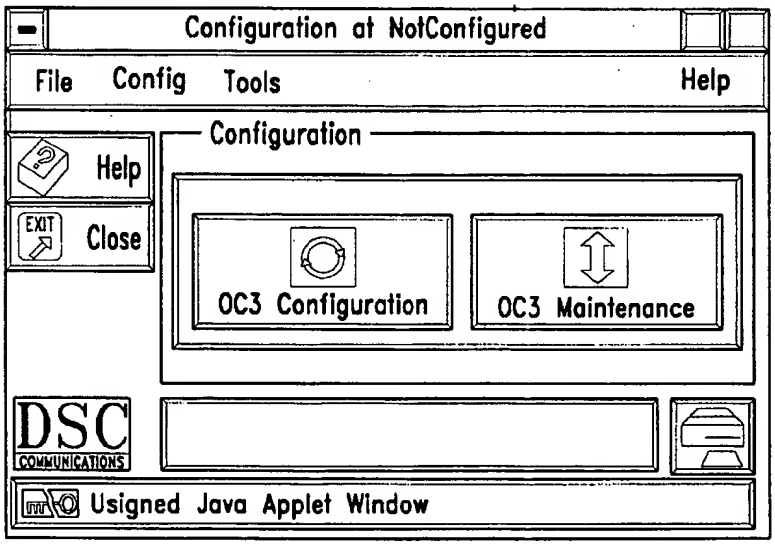

Top Level Launcher at NotConfigured
File
Config
Tools
Help
Top Level Launcher
Help
EXIT
Close
Monitor
Configuration
Application
Performance
Security
DSC
COMMUNICATIONS
Usigned Java Applet Window

FIG. 13


Configuration at NotConfigured
File
Config
Tools
Help
Configuration
Help
EXIT
Close
OC3 Configuration
OC3 Maintenance
DSC
COMMUNICATIONS
Usigned Java Applet Window

TELECOMMUNICATIONS SWITCH MANAGEMENT SYSTEM

TECHNICAL FIELD OF THE INVENTION

The present invention relates in general to the field of telecommunications switching systems. More particularly, the present invention is related to a Telecommunications Switch Management System for use with telecommunications switching systems.

BACKGROUND OF THE INVENTION

Conventional telecommunications switching systems employ centralized switching facilities which result in undesirable lengthy switching paths. Therefore, it is desirable to implement distributed telecommunications switching systems which do not require centralized switching facilities. However, elaborate management systems normally are required in order to provide users and operators with the ability to control, configure and monitor the various switches and other components which make up a typical distributed telecommunications switching system For example, an operator or user must be able to control, configure and monitor a distributed switching system's individual application cards, as well as the communication busses which interconnect those application cards

Conventional distributed telecommunications switching systems use dedicated Operational Support Systems ("OSSs") and relatively complex and cryptic command-driven user interface systems in order to provide users with the ability to control, configure and monitor distributed switching systems. These dedicated OSSs are cumbersome to develop, maintain, upgrade and expand upon. Additionally, the command-driven user interfaces are relatively cryptic, cumbersome, non-intuitive and difficult for users to learn and use.

The dedicated OSSs which provide management and support functions for telecommunications switching systems are relatively inflexible and difficult to develop, maintain, upgrade and expand because they normally use dedicated architectures, rather than more desirable and flexible open architectures Additionally, the architectures for these dedicated OSSs normally are unsuitable for interfacing with standardized communications links such as intranets or the internet. Therefore, a need has arisen for a telecommunications switch management and support system which will provide increased flexibility, upgradability, expandability, and ease of development and maintenance.

SUMMARY OF THE INVENTION

In accordance with the present invention, a telecommunications switch management system is provided which substantially eliminates or reduces the disadvantages and problems associated with prior management systems for distributed telecommunications switching systems

The telecommunications switch management system of the present invention is flexible and relatively easy to develop, maintain, upgrade and expand. Additionally, the telecommunications switch management system can interface with standardized communications links such as the Internet. The telecommunications switch management system of the present invention enables one or more users to remotely access the telecommunications switching system for any desired purpose, such as to monitor, control or reconfigure the telecommunications switching system.

The telecommunications switch management system of the present invention contains a system manager building block in communication with a remote computer. The system manager building block is also in communication with a system management interface building block, which contains a command interpreter building block and a system command interface building block. The command interpreter building block is in communication with the system manager building block and the system command interface building block. The system command interface building block contains at least one client building block. The client building blocks located in the system command interface building block are each in communication with a corresponding server building block, each of which in turn is in communication with the telecommunications switching system. The system manager building block provides communication between the remote computer and the system management interface building block. The system management interface building block provides communication between the system manager building block and the one or more servers which are in communication with the telecommunications switching system.

In another aspect of the invention, the client building blocks and server building blocks can include a system security manager client building block in communication with a system security manager server building block for providing the telecommunications switching system with various security functions. In still another aspect of the invention, the client building blocks and server building blocks can include a bearer manager client building block in communication with a bearer manager server building block for providing users with the ability to perform various management and monitoring functions on the telecommunications switching system. In yet another aspect of the invention, the client building blocks and server building blocks can include a fault manager client building block in communication with a fault manager server building block for providing users with the ability to review various types of faults which have occurred in the telecommunications switching system. In another aspect of the invention, the client building blocks and server building blocks can include a test manager client building block in communication with a test manager server building block for providing users with the ability to perform various tests on the telecommunications switching system. In still another aspect of the invention, the client building blocks and server building blocks can include a performance manager client building block in communication with a performance manager server building block for providing users with the ability to review the performance of the telecommunications switching system. In yet another aspect of the invention, the client building blocks and server building blocks can include a configuration management client building block in communication with a configuration management server building block for providing users with the ability to configure the various attributes of the telecommunications switching system.

In another aspect of the invention, the remote computer communicates with the system manager building block using the Internet inter-ORB (Object Request Broker) protocol ("IIOP") or the Hypertext Transport Protocol ("HTTP"). In still another aspect of the invention, the various building blocks of the telecommunications switch management system can communicate with one another by sending and receiving messages In yet another aspect of the invention, the various building blocks of the telecommunications switch management system can be designed using the well-known Common Object Request Broker Architecture ("CORBA"), and can communicate with one another using the CORBA communications protocol.

A technical advantage of the telecommunications switch management system of the present invention is its ability to provide multiple users remote access to telecommunications switching systems, for all of the same purposes as would be available using a dedicated terminal located proximate to the telecommunications switching system. Another technical advantage of the telecommunications switch management system of the present invention is its design flexibility and the relative ease with which it can be developed, maintained, upgraded and expanded. Still another technical advantage of the telecommunications switch management system of the present invention is its ability to interface with standardized communications links such as the Internet, and to use standardized CORBA architectures and communications protocols.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of the present invention and the advantages thereof, reference is now made to the following description taken in conjunction with the accompanying drawings in which like references indicate like features and wherein:

FIG. **1** is a high-level block diagram of the telecommunications switch management system of the present invention

FIG. **2** is an exemplary process flow diagram for the operation of the GUI Launcher of the present invention.

FIGS. **3**A–B are exemplary process flow diagrams for the operation of the Full Group Privileges Access Mechanism of the present invention.

FIG. **4** is an exemplary first display in the series of displays provided by the Graphical Shelf Navigator of the present invention.

FIG. **5** is an exemplary next display in the series of displays provided by the Graphical Shelf Navigator of the present invention.

FIG. **6** is an exemplary next and final display in the series of displays provided by the Graphical Shelf Navigator of the present invention.

FIG. **7** is an exemplary process flow diagram for the operation of the Graphical Shelf Navigator of the present invention.

FIG. **8** is an exemplary display of the pull-down menus of the Graphical Shelf Navigator of the present invention.

FIG. **9** is another exemplary display of the pull-down menus of the Graphical Shelf Navigator of the present invention

FIG. **10** is an exemplary process flow diagram for the operation of the pull-down menus of the Graphical Shelf Navigator of the present invention

FIG. **11** is an exemplary Login Screen provided by the GUI Launcher of the present invention.

FIG. **12** is an exemplary top-level display screen provided by the GUI Launcher of the present invention

FIG. **13** is an exemplary next-level display screen provided by the GUI Launcher of the present invention.

FIG. **14** is a high-level block diagram of a distributed telecommunications switching system which utilizes the telecommunications switch management system of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

FIG. **14** depicts a block diagram of a distributed Telecommunications Switching System **230** which utilizes the present invention. The distributed Telecommunications Switching System **230** includes a Service Unit Subsystem **232** which provides control and management on an advanced intelligent network ("AIN") service platform using information network architecture ("INA") software design principles. Distributed Telecommunications Switching System **230** also includes a plurality of Delivery Unit Subsystems **234** that provide the message transport mechanism for call information under the control and direction of Service Unit Subsystem **232**. Service Unit Subsystem **232** and Delivery Unit Subsystems **234** communicate with one another through a Fiber Optic Ring **236**. Call information is transported between the multiple Delivery Unit Subsystems **234**, and between each Delivery Unit Subsystem **234** and Service Unit Subsystem **232** on Fiber Optic Ring **236**, preferably in asynchronous transfer mode ("ATM") cell format

The Service Unit Subsystem **232** provides the control and management functions for the distributed Telecommunications Switching System **230**, and is separated from the transport mechanism function of Delivery Unit Subsystems **234**. This separation of functionality between the Service Unit Subsystem **232** and the Delivery Unit Subsystems **234** allows each subsystem to evolve and be upgraded independently, in order to support new services or new technologies for enhancements to either subsystem. The Service Unit Subsystem **232** can be constructed to support multiple types of Delivery Unit Subsystems **234** which can provide multiple services including broadband, video, conventional telephone, and personal communications services to consumers on the public telephony network Service Unit Subsystem **232** and Delivery Unit Subsystems **234** of the distributed Telecommunications Switching System **230** may either be grouped within a single geographic area or may be geographically disbursed in several remote areas while maintaining the same distributed nature of the switching function to be performed

The centralized control and management provided by Service Unit Subsystem **232** allows a user to be connected to different Delivery Unit Subsystems **234** while maintaining a common directory number Delivery Unit Subsystem **234** provides the switching fabric for distributed Telecommunications Switching System **230**. Delivery Unit Subsystems **234** may be dedicated to a specific type of service or may accommodate multiple services.

The Fiber Optic Ring **236** allows the communication of service control, user traffic transport (including video, data, image and voice) and operations, administration, maintenance and provisioning ("OAM&P"). Fiber Optic Ring **236** provides quality information transmission and dual physical path transmission capability between the Service Unit Subsystem **232** and Delivery Unit Subsystems **234**. Information may be transmitted between subsystems along one portion of the Fiber Optic Ring **236**, leaving the other portions of the Fiber Optic Ring **236** available for simultaneous transmissions between other subsystems within the distributed Telecommunication Switching System **230**. Additionally, distributed Telecommunications Switching System **230** can dynamically allocate and reallocate bandwidths for Fiber Optic Ring **236** transmission in order to accommodate periods of increased information demand.

Other features of distributed Telecommunications Switching System **230** include, but are not limited to, industry-standard operating systems, object-oriented development methodology, C++ implementation language, location-transparent interfaces using CORBA (Common Object Request Broker Architecture), a name-based messaging

system, a well-defined OAM&P architecture, management interfaces, and encapsulation and intelligence. These and other features of distributed Telecommunications Switching System **230** are further described in U.S. Pat. No. 5,495,484, which is hereby incorporated by reference. CORBA is fully described in "The Common Object Request Broker: Architecture and Specification," which is published by the Object Management Group and X Open, and which is hereby incorporated by reference.

The present invention provides a Telecommunications Switch Management System for operation with distributed Telecommunications Switching System **230**. FIG. **1** depicts a high-level block diagram of the Telecommunications Switch Management System of the present invention, including the various software building blocks which comprise the Telecommunications Switch Management System of the present invention. A building block is defined to be one or more software objects and routines which can be deployed, upgraded and maintained in a software repository, and which also can be used by applications, either alone or in combination, in order to perform specific functions or operations. Additionally, building blocks normally have message interfaces. FIG. **1** depicts the following building blocks of the Telecommunications Switch Management System of the present inventions each of which will be discussed below in additional detail System Manager **18**, System Security Manager Client **54**, System Management Interface **56**, System Security Manager Server **58**, Command Interpreter **62**, System Command Interface **64**, Bearer Manager Client **66**, Fault Manager Client **68**, Test Manager Client **70**, Performance Manager Client **72**, Configuration Management Client **74**, Bearer Manager Server **76**, Fault Manager Server **78**, Test Manager Server **80**, Performance Manager Server **82**, and Configuration Management Server **84**

The Telecommunications Switch Management System of the present invention preferably includes a Graphic User Interface (GUI) Launcher **8** for the Telecommunications Switch Management System. GUI Launcher **8** includes Remote Computer **10**, communications link **12**, Remote Server **14**, communications link **16**, and System Manager **18**. Remote Computer **10** in turn contains Browser software **11**. System Manager **18** in turn contains Runtime Library software **19**. Remote Computer **10** serves as a GUI Browser and communicates via communications link **12** with Remote Server **14**, and also via communications link **16** with System Manager **18**, as will be further described.

Browser **11** can be any type of system capable of accessing telecommunications link **12** Server Page **20** resides on Remote Server **14** and contains the application program necessary to enable Remote Computer **10** to communicate with the Telecommunications Switching System **230**. A user at Remote Computer **10** initiates a system access session by establishing communication over link **12** with Remote Server **14**. In response, Remote Server **14** downloads the application program to Remote Computer **10**, which enables Remote Computer **10** to communicate with Telecommunications Switching System **230**. Although this application program generally may be of any type, it typically is in the form of a Java Applet **22**. Once Java Applet **22** has been loaded into Remote Computer **10**, Remote Computer **10** can communicate in a stand-alone capacity with the Telecommunications Switching System **230** through communications link **16** and System Manager **18**. Thus, once Java Applet **22** has been loaded into Manufacture and Sale of Tubes for Pneumatic Tires for Vehicle WheelsRemote Computer **10**, Remote Computer **10** can communicate with the Telecommunications Switching System **230** without the need for any further communication with Remote Server **14**.

The arrangement of GUI Launcher **8** enables one or more authorized users to access the Telecommunications Switching System **230** from any location having a remote computer system. Thus, authorized users located anywhere can access the Telecommunications Switching System **230** for all of the same purposes as could a user of a dedicated terminal located proximate to the Telecommunications Switching System **230**. These purposes include, for example, the test and reconfiguration of the Telecommunications Switching System **230**, as well as the monitoring of the Telecommunications Switching System's performance, faults and security system.

Although Remote Server **14** generally can be located anywhere, as depicted in FIG. **1**, Remote Server **14** may for example be configured to be included within System Manager **18**. In such a case where Remote Server **14** is included within System Manager **18**, Remote Computer **10** would communicate with System Manager **18**, and also with Remote Server **14** contained therein, via communications link **16**. Communications link **12** therefore would not be required if Remote Server **14** were included within System Manager **18**.

Although Remote Computer **10** can be any type of computer system, it may comprise for example an ftSparc (fault-tolerant Sparc) workstation, which comprises a Sun Workstation and UNIX Solaris Operating System, or a personal computer (PC), including a portable PC such as a laptop computer. Similarly, although Remote Server **14** may be any type of servers it may comprise an HTML (Hypertext Markup Language) Server, for example. Additionally, Server Page **20** may for example comprise an HTML Page. Communication links **12** and **16** may be of any type, but may comprise for example an Incranet communications link or a telephone modem in combination with a standard Internet telephone line communications link. In the event that telecommunications link **12** is a standard Internet telephone line, Browser **11** may be any Web Browser, such as NETSCAPE or MICROSOFT's INTERNET EXPLORER, for example. The communications protocol used by communications links **12** and **16** may comprise the IIOP (Internet Inter-ORB (Object Request Broker) Protocol)) or HTTP (Hypertext Transport Protocol) protocols, for example. Although System Manager **18** can be any type of message passing and handling system, it may for example comprise a Message Object Stream System (MOSS)

FIG. **2** depicts an exemplary process flow for the operation of GUI Launcher **8** beginning with Block **24**. In order to use GUI Launcher **8** to access the Telecommunications Switching System **230**, a user at Remote Computer **10** initializes Browser **11** to access telecommunications link **12**, as shown in Block **24**. As shown in Block **26**, Browser **11** then accesses Remote Server **14** via communications link **12**. In Block **28**, Remote Computer **10** in combination with Browser **11** access the address of Server Page **20** which is located on Remote Server **14**. Remote Server **14** then provides the address of Server Page **20** to Browser **11** running on Remote Computer **10** As shown in Block **30**, Remote Server **14** then provides Remote Computer **10** with the application program necessary to enable Remote Computer **10** to communicate with the Telecommunications Switching System **230**. Typically, this application program is provided to Remote Computer **10** in the form of Java Applet **22**.

In Block **32**, Remote Computer **10** in conjunction with Java Applet **22** provide the Remote Computer user's User

Identification (ID) and password to System Manager **18** via communications link **16**. System Manager **18** contains Runtime Library **19**, in which is maintained a database of authorized User IDs and passwords. Using its Runtime Library **19**, System Manager **18** verifies the Remote Computer user's User ID and password, as shown in Block **34**. As shown in Block **36**, assuming the User ID and password are both valid, System Manager **18** establishes a socket connection between Remote Computer **10** and System Security Manager Client **54** within System Management Interface **56**, depicted in FIG. **1**. Although System Manager **18** and System Management Interface **56** may be designed using any suitable software architecture, they may for example be designed using the well known CORBA architecture

System Security Manager Client **54**, in conjunction with System Security Manager Server **58** which is part of Servers **60**, verifies the Remote Computer user's ID and Password against a database of User IDs and Passwords, as shown in Block **38**. As shown in Blocks **40** and **42**, if the user's User ID and Password are valid, System Security Manager Client **54** sends a message to Remote Computer **10** indicating a successful logon. If on the other hand, either the user's User ID or Password is invalid, System Security Manager Client **54** sends a message to Remote Computer **10** indicating that the logon attempt has failed, as shown in Blocks **40** and **44**. System Management Interface **56**, System Security Manager Client **54** and System Security Manager Server **58** will each be described in further detail below.

In Block **46**, once a successful logon has been established, Java Applet **22** in Remote Computer **10** launches and runs the GUI Launcher so that the Remote Computer user can access and control the Telecommunications Switching System **230** from Remote Computer **10**. As described previously, Remote Computer **10** in conjunction with Java Applet **22** operate in a stand-alone capacity without the need for additional communication between Remote Computer **10** and Remote Server **14**. While the GUI Launcher is running, Remote Computer **10** in conjunction with Java Applet **22** send messages representative of the Remote Computer user's input to System Manager **18**, and also receive from System Manager **18** messages relating to the Telecommunications Switching System **230**, as shown in Block **48**. Additionally, in Block **50**, System Security Manager Client **54** in conjunction with System Security Manager Server **58** maintain records regarding which Users have logged on, as well as when and for how long they each have logged on.

When the user of Remote Computer **10** wishes to terminate the logon session, the user enters the appropriate command at Remote Computer **10**, and the GUI Launcher sends a message instructing System Manager **18** to terminate the session, as shown in Block **52**. When the logon session has been terminated, Remote Computer **10** does not retain Java Applet **22**. Rather, for the next logon session from Remote Computer **10**, Remote Server **14** again provides to Remote Computer **10**, typically in the form of a Java Applet **22**, the application program which enables Remote Computer **10** to communicate with the Telecommunications Switching System **230**. This eliminates the need to install and maintain multiple copies of the necessary application program on one or more Remote Computers **10**. Instead, the necessary application program need only be installed, maintained and updated on Remote Server **14**.

FIGS. **11–13** depict exemplary displays provided by GUI Launcher **8** for enabling a user to access the Telecommunications Switch Management System of the present invention. FIG. **11** depicts an exemplary Login Screen which prompts the user to enter a User ID and password The GUI Launcher **8** will not permit the user to continue to the next GUI Launcher display unless the user enters a valid User ID and password

FIG. **12** depicts an exemplary top-level display provided by GUI Launcher **8**p which would be generated if the user enters a valid User ID and password in the Login Screen depicted in FIG. **11** This top-level display provides the user with the first layer of selections regarding the type of access the user is seeking into the Telecommunications Switch Management System and the accompanying Telecommunications Switching System **230**. In the example depicted in FIG. **12**! the user can select from the GUI Launcher **8** options designated as "Monitor", "Configuration", "Applications", "Performance", and "Security". Other selections may also be provided instead of, or in addition to, the exemplary selections depicted in FIG. **12**.

FIG. **13** depicts an exemplary next-level display provided by GUI Launcher **8** The GUI Launcher **8** would generate the exemplary display depicted in FIG. **13** if the user selects the option designated as "Configuration" in the display depicted in FIG. **12**. In the example depicted in FIG. **13**, the user can select from options designated as "OC3 Configuration" and "OC3 Maintenance". These exemplary selections could for example provide the user access to the Graphical Shelf Navigator, which is discussed in additional detail below. Other selections may also be provided in addition to or instead of the exemplary selections depicted in FIG. **13**.

In addition to GUI Launcher **8**, the system of FIG. **1** provides additional unique elements of the Telecommunications Switch Management System configured in a unique architecture so as to provide capabilities and flexibility not available in systems of the prior art. FIG. **1** depicts these additional elements and the architecture of the Telecommunications Switch Management System for operation with the Telecommunications Switching System **230**. In particulars FIG. **1** depicts System Management Interface **56** which comprises Command Interpreter **62** and System Command. Interface **64**. System Management Interface **56** communicates with Servers **60** in order to provide communication with the Telecommunications Switching System **230**. System Command Interface **64** comprises multiple Clients, namely System Security Manager Client **54**, Bearer Manager Client **66**, Fault Manager Client **68**, Test Manager Client **70**, Performance Manager Client **72** and Configuration Management Client **74**. Servers **60** comprise multiple Servers, namely System Security Manager Server **58**, Bearer Manager Server **76**, Fault Manager Server **78**, Test Manager Server **80**, Performance Manager Server **82** and Configuration Management Server **84**. Each Server communicates with a corresponding Client, as depicted in FIG. **1**.

System Management Interface **56** and Servers **60**, in conjunction with GUI Launcher **8**, permit users to access and communicate with the Telecommunications Switching System **230** for purposes such as the test and reconfiguration of the Telecommunications Switching System **230**, as well as the monitoring of Telecommunications Switching System **230**'s performance, faults and security system. Users may use Remote Computer **10** to send commands and messages to the Telecommunications Switching System **230**, as well as to receive commands and messages therefrom.

Commands and Messages can be sent and received between Remote Computer **10** and System Manager **18** via communications link **16**. Additionally, System Manager **18** can communicate with Command Interpreter **62** within

System Management Interface **56**. System Manager **18** processes commands and messages being sent by Remote Computer **10** to be compatible with, and suitable for receipt by, Command Interpreter **62**, and also processes commands and messages being sent by Command Interpreter **62** to be compatible with, and suitable for receipt by, Remote Computer **10**. Although communications link **16** may use any appropriate communications protocol, the protocol may comprise the IIOP or HTTP protocols, for example. Additionally, although System Manager **18** and Command Interpreter **62** may be designed using any suitable software architecture, they may for example be designed using the well known CORBA architecture. In such a case where System Manager **18** and Command Interpreter **62** are designed using the CORBA architecture, System Manager **18** and Command Interpreter **62** would communicate with one another using CORBA communications protocol.

System Management Interface **56** serves to determine, for each message and command sent by Remote Computer **10** via System Manager **18**, which client located in System Command Interface **64** and which corresponding Server **60** must be requested in order to implement that message or command. Command Interpreter **62**, located within System Management Interface **56**, interprets all messages and commands received from Remote Computer **10** via System Manager **18**, before forwarding the message or command on to System Command Interface **64**. System Command Interface **64**, in conjunction with System Security Manager Client **54** and System Security Manager Server **58**, then determines whether the user of Remote Computer **10** is authorized to implement the function or command received from Remote Computer **10** via System Manager **18**. The security-related functions of System Security Manager Client **54** and System Security Manager Server **58** will be discussed below in additional detail

Command Interpreter **62** can communicate with System Command Interface **64**, and with Clients **54, 66, 68, 70, 72** and **74** therein. Command Interpreter **62** processes commands and messages being sent by System Manager **18** of GUI Launcher **8** to be compatible with, and suitable for receipt by, System Command Interface **64**, and also processes commands and messages being sent by System Command Interface **64** to be compatible with, and suitable for receipt by, System Manager **18** Although any appropriate communications protocol may be used for communication between Command Interpreter **62** and System Command Interface **64**, the protocol may comprise the Library Application Programming Interface (API) protocol, for example.

System Command Interface **64**, and Clients **54, 66, 68, 70, 72** and **74** therein, can communicate with Servers **60**. Each Client in System Command Interface **64** communicates with a corresponding Server in Servers **60**. More specifically, System Security Manager Client **54**, Bearer Manager Client **66**, Fault Manager Client **68**, Test Manager Client **70**, Performance Manager Client **72** and Configuration Management Client **74** communicate with System Security Manager Server **58**, Bearer Manager Server **76**, Fault Manager Server **78**, Test Manager Server **80**, Performance Manager Server **82** and Configuration Management Server **84**, respectively. System Command Interface **64** processes commands and messages being sent by Command Interpreter **62** to be compatible with, and suitable for receipt by, Servers **60**, and also processes commands and messages being sent by Servers **60** to be compatible with, and suitable for receipt by, Command Interpreter **62**.

System Security Manager Client **54** in conjunction with System Security Manager Server **58** provide system security administration for the Telecommunications Switch Management System, and for the accompanying Telecommunications Switching System **230**. These security-related functions will be discussed below in additional detail.

Bearer Manager Client **66** in conjunction with Bearer Manager Server **76** enable the user of Remote Computer **10** to perform various review, management and control functions regarding the status and configuration of Telecommunications Switching System **230**. These functions include, but are not limited to, reviewing socket connections, performing bus management functions, and assigning available switching channels within Telecommunications Switching System **230**.

Fault Manager Client **68**, in conjunction with Fault Manager Server **78**, enables the user of Remote Computer **10** to review the fault status of, and the historical fault statistics for, Telecommunications Switching System **230**. Test Manager Client **70**, in conjunction with Test Manager Server **80**, enables the user of Remote Computer **10** to perform various tests on Telecommunications Switching System **230**. Test Manager Client **70** in conjunction with Test Manager Server **80** first determine whether the requested test will disrupt the normal operation of Telecommunications Switching System **230**. Test Manager Client **70** in conjunction with Test Manager Server **80** then have the requested test performed by the appropriate client located in System Command Interface **64** and the appropriate corresponding Server **60**. Test Manager Client **70** in conjunction with Test Manager Server **80** next collate the results of the test performed, and return those results back to the user of Remote Computer **10** via System Management Interface **56** and System Manager **18**.

Performance Manager Client **72**, in conjunction with Performance Manager Server **82**, enables the user of Remote Computer **10** to review various data regarding the performance of Telecommunications Switching System **230**. Performance Manager Client **72**, in conjunction with Performance Manager Server **82**, also enables the user of Remote Computer **10** to modify or reset, or set the thresholds on, the various performance-monitoring data counters of Telecommunications Switching System **230**.

Configuration Management Client **74**, in conjunction with Configuration Management Server **84**, enables the user of Remote Computer **10** to implement the creation, deletion, removal, restoration and modification of various attributes of the equipment and facilities of Telecommunications Switching System **230**.

Although System Command Interface **64**, and Clients **54, 66, 68, 70, 72** and **74** therein, and Servers **60** may be designed using any suitable software architecture, they may for example be designed using the well known CORBA architecture. In such a case where System Command Interface **64** and Servers **60** are designed using the CORBA architecture, System Command Interface **64** and Servers **60** would communicate with one another using CORBA communications protocol Additionally, the application programs of Servers **60** may be constructed using any suitable method, but may be constructed using the well known C++ object-oriented programming language, for example.

Messages and commands sent from Remote Computer **10** to System Manager **18**, and then to Command Interpreter **62**, System Command Interface **64** and Servers **60** may for example represent commands from the Remote Computer user for reconfiguring the Telecommunications Switching System **230**, or queries from the Remote Computer user regarding the status of the Telecommunications Switching System **230**. On the other hand, messages and commands

sent from Servers **60** may for example represent messages regarding the status or configuration of the Telecommunications Switching System **230**, or commands to be directed to Remote Computer **10** instructing the user regarding how to reconfigure or determine the status of the Telecommunications Switching System **230**.

The present invention also provides a Full Group Privileges Access Mechanism which provides security administration and account administration for the Telecommunications Switch Management System and the accompanying Telecommunications Switching System **230**. The Full Group Privileges Access Mechanism serves to ensure that only authorized users are able to access the Telecommunications Switch Management System and the Telecommunications Switching System **230**. The Full Group Privileges Access Mechanism also serves to further ensure that, even if a particular user is generally authorized to access the system, the user cannot access any portion or function of the system which the user is not specifically authorized to access.

As depicted in FIG, **1**, the Full Group Privileges Access Mechanism is provided by System Manager **18** and Runtime Library **19** in conjunction with System Security Manager Client **54**, which is located in System Management Interface **56**, and System Security Manager Server **58**. The Full Group Privileges Access Mechanism maintains records of a variety of pertinent information in Runtime Library **19**, in order to provide security and account administration for the system. Although records of any suitable information may be maintained, the Full Group Privileges Access Mechanism may for example maintain records regarding the list of authorized users, user groups, users' authorization levels, and the minimum authorization levels required for a user to execute each of the Telecommunications Switch Management System's available commands, or access each of the system's functions.

More specifically, the Full Group Privileges Access Mechanism may for example maintain records of (a) authorized User IDs; (b) the date and time each User ID expires and therefore becomes unauthorized; (c) authorized Passwords for each authorized User ID; (d) the date and time each Password expires and therefore becomes unauthorized; (e) the authorization level for each authorized User ID; (f) the User Group of which each user having an authorized User ID is a member; (g) the minimum authorization level required to execute each available command and access each available function; and (h) the User Group or Groups authorized to execute each available command and access each available function.

When a user attempts to access the Telecommunications Switch Management System, the Full Group Privileges Access Mechanism compares the user's User ID and Password against its records of authorized User IDs, the expiration date and time for each authorized User ID, authorized Passwords for each authorized User ID, and the expiration date and time for each authorized Password. The Full Group Privileges Access Mechanism will refuse the user access to the Telecommunications Switch Management System unless the user has a valid and unexpired User ID and Password. In the event that the Full Group Privileges Access Mechanism refuses to provide access to the Telecommunications Switch Management System, the Full Group Privileges Access Mechanism generates a record of the attempted unauthorized access, so that unauthorized activities may be recorded and subsequently investigated if necessary.

As discussed above, the Full Group Privileges Access Mechanism also maintains records of the authorization level which has been assigned to each authorized user and User ID. A user's authorization level determines which functions of the Telecommunications Switch Management System the user is authorized to access, and which commands the user is authorized to execute. Thus, each function and command provided by the Telecommunications Switch Management System has a minimum authorization level assigned to it. In order for a user to access a particular system function or execute a particular system command, there must be assigned to that user an authorization level at least as high in number as the authorization level assigned to that function or command In this way, a user having a relatively high authorization level, such as a system administrator for example, can be provided more privileges and greater access to functions and commands than would an ordinary type of user who may, for example, only need to determine the status of the Telecommunications Switching System **230**.

Although there may be any number of different authorization levels, the Full Group Privileges Access Mechanism may be configured to provide 4, 16, 64 or 256 different authorization levels, for example. In a system configured for 16 different authorization levels (numbered 1 through 16), for example, a user having an authorization level of 6 would be able to access any function or execute any command having assigned to it an authorization level of 6 or lower. Similarly, a user having an authorization level of 1 would only be able to access functions or execute commands which have an authorization level of 1, whereas a user having an authorization level of 16 would be able to access all available functions and execute all available commands.

For the above-described example in which the Full Group Privileges Access Mechanism is configured to provide 16 different authorization levels, an exemplary list of several functions and commands, together with their respective assigned minimum authorization levels, is presented below in Table 1.

Manufacture and Sale of Tubes for Pneumatic Tires for vehicle Wheels

TABLE 1

Function/Command	Minimum Authorization Level
Create	14
Change	13
Delete	15
Display	6
Administration Functions	16

In this example, because functions and commands such as the exemplary Create, Change, Delete and Administration functions could potentially have a great effect on the Telecommunications Switch Management System and the associated Telecommunications Switching System **230**, these functions and commands have been assigned the relatively high minimum authorization levels of 14, 13, 15 and 16, respectively. Thus, only users having authorization levels of 14 through 16 would be able to access the Create function; only users having authorization levels of 13 through 16 would be able to access the Change function; only users having authorization levels of 15 or 16 would be able to access the Delete function; and only users having an authorization level of 16 would be able to access the Administration Functions.

On the other hand, because the exemplary Display function would not affect the Telecommunications Switch Management System to the extent that the exemplary Create, Change, Delete and Administration functions would, the

Display function has in this example been assigned the much lower minimum authorization level of 6. Thus, any users having authorization levels of 6 through 16 would be able to access and execute the Display function.

In addition to maintaining records of authorized User IDs, Passwords, expiration dates, users' authorization levels, and the minimum authorization level assigned to each function and command, the Full Group Privileges Access Mechanism also maintains records regarding User Groups, a list of authorized users assigned to each User Group, and a list of functions and commands which members of each User Group are authorized to access. User Groups are an additional mechanism by which the Full Group Privileges Access Mechanism provides security administration and account administration for the Telecommunications Switch Management System.

Each User Group comprises a list of authorized users which have been assigned to that User Group. It is possible for a particular user to be assigned to more than one User Group. In addition, each User Group has assigned to it a list of functions which members of that User Group are authorized to access, and a list of commands which members of that User Group are authorized to execute. Thus, in order for a particular user to access a particular function or execute a particular command of the Telecommunications Switch Management System, the user must be a member of one or more of the User Groups authorized to access that function or execute that command

Although there may be any type and number of User Groups, an exemplary set of User Groups might include a Tester Group, Maintenance Group and Administrator Group. Each of these User Groups would have associated with it a set of functions which each member of the respective User Group would be entitled to access, and a set of commands which each member of the respective User Group would be entitled to execute. Using the same set of exemplary functions and commands presented in Table 1 above, an exemplary set of User Groups, together with the functions and commands which members of each User Group are entitled to access and execute, are presented below in Table 2.

Manufacture and Sale of Tubes for Pneumatic Tires for Vehicle Wheels

TABLE 2

	Function/Command Access				
User Group	Create	Change	Delete	Display	Admin. Fcns.
Tester	No	No	No	Yes	No
Maintenance	Yes	Yes	No	Yes	No
Administrator	Yes	Yes	Yes	Yes	Yes

In the example presented in Table 2, members of the Tester User Group have been authorized to access the Display function, but not the Create, Change, Delete or Administration functions; members of the Maintenance User Group have been authorized to access the Create, Change and Display functions, but not the Delete or Administration functions; and members of the Administrator User Group have been authorized to access each of the Create, Change, Delete, Display and Administration functions.

Thus, in the present example, an authorized user who is a member of the Administrator User Group would have access to a greater number of functions and commands than would members of the Maintenance and Tester User Groups, and members of the Maintenance User Group would have greater access to commands and functions than would members of the Tester User Group. As a general rule, relatively few User Groups would be provided access to functions and commands which might have a relatively large effect on the Telecommunications Switch Management System and the associated Telecommunications Switching System 230, such as the Delete and Administration functions On the other hand, a larger number of User Groups typically would be provided access to functions and commands which would have little or no effect on the system, such as the Display function.

Typically, a User Group, such as the Administrator User Group, would include only user members such as system administrators who would require relatively complete access to the functions and commands provided by the Telecommunications Switch Management System. Accordingly, the exemplary Administrator User Group would be provided access to most or all of the available functions and commands, as in the illustrative example provided in Table 2. On the other hand, a User Group, such as the Tester User Group, would include user members authorized to review the status and configuration of the system, but not authorized to alter or reconfigure the system. Accordingly, the Tester User Group would be provided access only to functions and commands which could have little or no impact on the system, such as the Display function.

As discussed above, in addition to maintaining records relating to the User Groups, the Full Group Privileges Access Mechanism also maintains records relating to the users' authorization levels and the minimum authorization level assigned to each function and command. In order to provide security administration for the Telecommunications Switch Management System, the Full Group Privileges Access Mechanism uses the records relating to the User Groups in combination with the records relating to authorization levels.

More specifically, in order for a user to access a particular function or execute a particular command of the Telecommunications Switch Management System, the Full Group Privileges Access Mechanism typically would require that the user both (a) be a member of a User Group authorized to access the desired function or execute the desired command, and (b) have an authorization level at least as high as the minimum authorization level assigned to the function or command. Although the Full Group Privileges Access Mechanism may also be configured to require only that (a) the user be a member of one of the User Groups authorized to access the desired function or execute the desired command, or (b) the user have an authorization level at least as high as the minimum authorization level assigned to the function or command, the Full Group Privileges Access Mechanism typically would be configured to require that a user meet both, rather than only one of, these two requirements. In providing security administration by using the records relating to the User Groups in combination with the records relating to authorization levels, the Full Group Privileges Access Mechanism can provide different access privileges to different users who are members of the same User Group.

In the event that a user attempts to access a function or execute a command which the user is not authorized to access or execute, the Full Group Privileges Access Mechanism prevents the user from accessing that function or executing that command Whenever the Full Group Privileges Access Mechanism refuses to permit a user to access a function or execute a command, the Full Group Privileges Access Mechanism generates a record of the attempted unauthorized access, so that unauthorized activities may be recorded and subsequently investigated, if necessary.

FIGS. 3A–B depict an exemplary process flow for the operation of the Full Group Privileges Access Mechanism, beginning with Block **86**. When a user attempts to access the Telecommunications Switch Management System depicted in FIG. **1** via Remote Computer **10**, Remote Computer **10** which operates as a GUI Browser provides the user's User ID and Password to System Manager **18**, as shown in Block **86**. As shown in Block **88**, System Manager **18**, in conjunction with System Security Manager Client **54** and System Security Manager Sever **58**, then access the records containing the list of valid User IDs and Passwords, which records are maintained in the System Manager Runtime Library **19**, and compare the user's User ID and Password to the list of valid User IDs and Passwords. As shown in Blocks **90** and **92**, if the Full Group Privileges Access Mechanism determines that the user's User ID or Password is not valid, the Full Group Privileges Access Mechanism generates a record of the attempted unauthorized access, and transmits a Failed Logon message to Remote Computer **10**, which in turn displays the message to the user.

If on the other hand the Full Group Privileges Access Mechanism determines the user's User ID and Password to be valid, the Full Group Privileges Access Mechanism establishes a logon session and a corresponding session key, as shown in Blocks **90** and **94**. In determining whether the user's User ID and Password are valid, the Full Group Privileges Access Mechanism typically would reference the above-described records of authorized User IDs, authorized Passwords, and the expiration date and time for each User ID and Password, which records are maintained in System Manager Runtime Library **19**.

As shown in Block **96**, if a logon session is established, the Full Group Privileges Access Mechanism starts a timeout clock which will terminate the logon session after a predetermined period of inactivity by the user. Thus, if a user at Remote Computer **10** is logged into the Telecommunications Switch Management System for a certain period of time without making any entries into Remote Computer **10**, the system will automatically terminate the user's logon session. This prevents unauthorized users from accessing the system if an authorized user who is logged on leaves Remote Computer **10** without first terminating the logon session.

As shown in Block **98**, when the authorized user wishes to access a function or execute a command of the Telecommunications Switch Management System, the user issues a command using Java Applet **22** running on Remote Computer **10**. The Java Applet **22** running on Remote Computer **10** then flattens the data representative of the user's User ID, the session key and the issued command, and sends this flattened data to System Manager **18**, as shown in Blocks **100** and **102**, The Full Group Privileges Access Mechanism then extracts the User ID, the session key and the issued command from the flattened data, and compares this information with the information in the Full Group Privileges Access Mechanism's records relating to User Groups and authorization levels which are maintained in System Manager Runtime Library **19**, as shown in Block **104**. Based on the user's authorization level and the User Groups of which the user is a member, the Full Group Privileges Access Mechanism determines whether the user is authorized to execute the command or to access the system function which the command accesses. In determining whether the user is authorized to execute the command or access the function, the Full Group Privileges Access Mechanism typically would reference the above-described records of the User Groups of which the user is a member, the User Groups authorized to execute each command and access each function, the user's authorization level, and the minimum authorization level required to execute each available command and access each available function.

As shown in Blocks **106** and **108**, if the user is not authorized to execute the command or access the function, the Full Group Privileges Access Mechanism generates a record of the attempted unauthorized access, and sends a message to Remote Computer **10** indicating that the user's attempt to access the Telecommunications Switch Management System has failed. As shown in Blocks **106** and **110**, if the user is authorized to execute the command or access the function, System Manager **18** transmits flattened data representative of the issued command to System Management Interface **56**. System Management Interface **56** then sends the issued command to the appropriate Server **60** via Command Interpreter **62** and the appropriate Client in System Command Interface **64**, as shown in Block **112**.

As shown in Block **114**, the appropriate Server **60** executes the command and then provides a response to Java Applet **22** running on Remote Computer **10**, in the form of a message routed to Remote Computer **10** through System Management Interface **56** and System Manager **18**. The Java Applet running on Remote Computer **10** displays a message denoting the response from Server **60** on Remote Computer **10** for the user, as shown in Block **116**. Although the applications of Servers **60** may be constructed using any suitable method, they may be constructed using the well known C++ programming language, for example.

The FIG. **1** system also includes a Graphical Shelf Navigator which provides a convenient GUI interface for accessing and implementing the features and functions of the Telecommunications Switch Management System. The Graphical Shelf Navigator enables the user to access and implement the Telecommunications Switch Management System's features and functions simply by making appropriate selections from a series of graphical displays and menus. The user can use the Graphical Shelf Navigator to conveniently and easily access the Telecommunications Switching System **230** for any purpose, such as for the test and reconfiguration of the Telecommunications Switching System **230** or for the monitoring of the Telecommunications Switching System **230**'s performance and faults.

The Graphical Shelf Navigator operates by prompting the user to select the particular portion of the Telecommunications Switching System **230** the user wishes to access or perform an operation on, and by also prompting the user to select the particular function or command the user wishes to execute on the selected portion of the Telecommunications Switching System **230**. The user may implement the desired selections using any appropriate keystrokes on Remote Computer **10**. Typically, however, the user implements the desired selections using any type of well known mouse commands, such as by moving the mouse to place a cursor on the portion of the display corresponding to the desired selection, and by then "clicking" the mouse on that portion of the display.

FIG. **4** depicts the first of the Graphical Shelf Navigator's series of graphical displays. The graphical display depicted in FIG. **4** represents the cabinet, shelves and application cards (i.e., the printed circuit boards which contain electronic components) which compose the Telecommunications Switching System **230**'s electronic hardware, as well as the particular shelf of application cards which the user selects Specifically, Cabinet Graphic **120** represents the cabinet which contains the electronic hardware of Telecommunications Switching System **230**. Shelf Graphics **122**, **124**, **126** and **128** represent the shelves within the cabinet

which contain the application cards. Application Card Graphics **130** represent the application cards which contain the Telecommunications Switching System **230**'s electronic components The darker shading of Shelf Graphic **122**, and of the Application Card Graphics **130** contained therein, denotes that the user has selected that shelf and those application cards The selection of this shelf is denoted in Status Bar **132**; in the particular example depicted in FIG. **4**, the selected shelf of application cards is designated as "Unit 0". Thus, Status Bar **132** serves to denote the designation of the particular shelf selected.

Once the user has selected the desired shelf, the user then selects from Icon Bar **133** the function which the user desires to perform on the selected shelf. In the graphical display depicted in FIG. **4**, the functions available to be performed on a selected shelf are designated as "Create", "Display", "Delete", "Refresh", "Zoom In", "Help", and "Close". Menu Bar **134** provides the user access to numerous menu functions and/or files related to the Graphical Shelf Navigator, and will be discussed below in additional detail.

Although the example of FIG. **4** depicts four shelves as containing application cards, as a general rule either one, two or three shelves can be empty. Similarly, although the example of FIG. **4** depicts the upper shelf (represented by Shelf Graphic **122**) as being selected, the user may select any shelf. The designation of any shelf which has been selected will be denoted in Status Bar **132**.

FIG. **5** depicts an example of one of the next graphical displays in the Graphical Shelf Navigator's series of graphical displays. The graphical display depicted in FIG. **5** would result if, in the graphical display depicted in FIG. **4**, the user selected the function designated by "Zoom In" to be performed on the selected shelf. The graphical display depicted in FIG. **5** represents the shelf of application cards which the user selected in the graphical display depicted in FIG. **4**, as well as the particular application card within the shelf which the user selects. Specifically, application Card Graphics **136**, **138**, **140**, **142**, **144**, **146**, **148**, **150**, **152**, **154**, **156**, **158**, **160**, **162**, **164** and **166** represent the individual application cards located in that shelf; the aggregate of all of these application cards is collectively represented by Application Card Graphics **130**. Empty Application Card Slot Graphics **168** and **170** represent empty application card slots located in that shelf, The darker shading of Application Card Graphic **138** denotes that the user has selected that application card. The selection of that application card is denoted in Status Bar **172**. In the particular example depicted in FIG. **5**, the selected application card is designated as "STGS". Thus, Status Bar **172** serves to denote the designation of the particular application card selected.

Once the user has selected the desired application card, the user then selects from Icon Bar **173** the function which the user desires to perform on the selected application card. In the particular example depicted in FIG. **5**, the functions available to be performed on a selected application card are designated as "Create", "Display", "Change", "Delete", "Refresh", "Help", and "Close" Menu Bar **174** provides the user access to numerous menu functions and/or files related to the Graphical Shelf Navigator, and will be discussed below in additional detail.

Although the example of FIG. **5** depicts a shelf having sixteen application cards and two empty application card slots, as a general rule a shelf may contain any number of application card slots and any number of application cards, up to and including the number of application card slots. Similarly, although the example of FIG. **5** depicts the application card represented by Application Card Graphic **138** as being selected, the user may select any application card. The designation of any application card which has been selected will be denoted in Status Bar **172**.

Once the user utilizes the graphical display depicted in FIG. **5** to select a particular application card and a function to be performed on that application card, the user is presented with the next and final display of the Graphical Shelf Navigator's series of displays, which display enables the user to fully implement the selected function on the selected application card. One example of such a display is depicted in FIG. **6**. FIG. **6** depicts such a display in the particular case where, in the graphical display depicted in FIG. **5**, the user selects the function which is designated by "Create" to be performed on the application card which is designated by "STGS". In order to implement the function designated by "Create" on the application card designated by "STGS", the user configures each of the parameters provided in Configuration Lines **176** as desired, and then invokes the "Apply" Command **178**. If, on the other hand, the user decides to not implement the function designated by "Create" on the application card designated by "STGS", the user invokes the "Dismiss" command **180**.

Although FIG. **6** depicts the Graphical Shelf Navigator's display in the particular case where the user has selected the function designated by "Create" to be performed on the application card designated by "STGS", the Graphical Shelf Navigator can provide such a display for every combination of available application cards and available functions. The visual appearance of each display, and the particular Configuration Lines **176** provided in each display, depend on the particular application card and the function selected by the user.

FIG. **7** depicts an exemplary process flow for the operation of the Graphical Shelf Navigator example depicted in FIGS. **4–6**. As shown in Block **182**, the Graphical Shelf Navigator begins by displaying to the user the graphical display depicted in FIG. **4**. While viewing this graphical display, the user utilizes Shelf Graphics **122**, **124**, **126** and **128** to select the shelf of application cards on which the user desires to perform a function, as shown in Block **184**. The user then uses Icon Bar **133** to select the function to be performed on the selected shelf of application cards, as shown in Block **186**.

As shown in Block **188**, the Graphical Shelf Navigator then changes the display to the graphical display depicted in FIG. **5**. While viewing this graphical display, the user then uses Application Card Graphics **130** to select the specific application card on which the user desires to perform a function, as shown in Block **190**. As shown in Block **192**, the user then utilizes Icon Bar **173** to select the function to be performed on the selected application card. As shown in Block **194**, the Graphical Shelf Navigator then changes the display to the display depicted in FIG. **6**, As shown in Block **196**, the user appropriately configures each of the parameters provided in Configuration Lines **176**. Finally, in order to execute the selected function on the selected application card, the user invokes the "Apply" Command **178**, as shown in Block **198**.

The Graphical Shelf Navigator also provides pull-down menus as an alternative way for a user to access and implement the features and functions of the Telecommunications Switch Management System. A user has the option to use these pull-down menus instead of the above-described series of graphical displays depicted in FIGS. **4** and **5**, in order to access and implement any of the features and functions of the Telecommunications Switch Management System.

As with the series of graphical displays described above, the pull-down menus operate by prompting the user to select the particular portion of the Telecommunications Switching System **230** the user wishes to access or perform an operation on, and by also prompting the user to select the particular function or command the user wishes to execute on the selected portion of Telecommunications Switching System **230**. The user may implement the desired pull-down menu selections using any appropriate keystrokes on Remote Computer **10**, but typically implements these selections using any type of well known mouse commands, such as by moving the mouse to place a cursor on the portion of the pull-down menu corresponding to the desired selection, and by then "clicking" the mouse on that portion of the menu.

FIG. **8** depicts the Graphical Shelf Navigator's Pull-Down Menus **200** and **202**, which provide an alternative way for a user to implement the selections which can be made using the graphical display depicted in FIG. **4**. Although the same Cabinet Graphic **120** and Icon Bar **133** depicted in FIG. **4** also appear in FIG. **8**, the Cabinet Graphic **120** and Icon Bar **133** become inactive once the user activates Pull-Down Menus **200** and **202**. Once Cabinet Graphic **120** and Icon Bar **133** become inactive, they can no longer be used to select portions of the Telecommunications Switching System **230**, or functions to be performed thereon.

The user activates Pull-Down Menu **200** by using Menu Bar **134**. In the exemplary Menu Bar **134** depicted in FIG. **8**, the available selections are designated "File", "Config", "Unit", "Device", "Facility", "Refresh", and "Help". FIG. **8** depicts the example where the user has selected the "Device" option from Menu Bar **134**. Based on the user's selection of the "Device" option, the Graphical Shelf Navigator generates Pull-Down Menu **200**, which provides the user with a selection of devices, namely application cards, having the designations "HLTP", "OTM", "STSM", "PCM", "MTXI", "SCAN", "ECHO", and "STGS". The user then selects the desired application card from Pull-Down Menu **200**. FIG. **8** depicts the particular example where the user has selected the application card designated by "STGS".

Once the user has selected the desired application card from Pull-Down Menu **200**, the Graphical Shelf Navigator then generates Pull-Down Menu **202**, which provides the user with a selection of functions which can be performed on the selected application card. In the example of FIG. **8**, the functions available are designated by "Create", "Change", "Display", and "Delete" FIG. **8** depicts the example where the user selects the function designated by "Create".

Although FIG. **8** depicts Pull-Down Menu **200** in the particular case where the user has selected the option designated as "Device" from Menu Bar **134**, the Graphical Shelf Navigator provides an appropriate pull-down menu for each available option in Menu Bar **134**. The appearance of each of those pull-down menus, and the selections provided therein, depend on the option selected from menu bar **134**. Similarly, although FIG. **8** depicts Pull-Down Menu **202** in the particular case where the user has selected the application card designated as "STGS" from Pull-Down Menu **200**, the Graphical Shelf Navigator provides an appropriate pull-down menu for each available application card appearing in Pull-Down Menu **200**. The appearance of each of those pull-down menus, and the selections provided therein, depend on the application card selected from Pull-Down Menu **202**.

In addition to accessing Pull-Down Menu **202** from Pull-Down Menu **200**, a user alternatively can access Pull-Down Menu **202** from the graphical display depicted in FIG. **56** FIG. **9** depicts the same graphical display as is depicted in FIG. **5**, which display represents a single shelf of application cards of Telecommunications Switching System **230** In order to access Pull-Down Menu **202** from the display depicted in FIG. **9**, the user selects an application card from Shelf Graphic **122**. Once the user has selected an application card, the Graphical Shelf Navigator then generates Pull-Down Menu **202**, which is the same as the Pull-Down Menu **202** depicted in FIG. **8**. As in the example depicted in FIG. **8**, the user then selects from the Pull-Down Menu **202** in FIG. **9** a function to be performed on the selected application card. Although FIG. **9** depicts Icon Bar **173**, which is also depicted in FIG. **5**, Icon Bar **173** becomes inactive once the user activates Pull-Down Menu **202**. Once Icon Bar **173** becomes inactive, it cannot be used to select functions to be performed on the selected application card.

In the example depicted in FIG. **9**, as in the example of FIG. **5**, the darker shading of Application Card Graphic **138** denotes that the user has selected that application card. The selection of that application card is denoted in Status Bar **172**. In the particular example depicted in FIG. **9**, the selected application card is designated as "STGS". Status Bar **172** denotes the designation of the particular application card selected.

Once the user has utilized Pull Down Menus **200** and **202** to select the desired application card and function, respectively, the Graphical Shelf Navigator then provides the user with the final display which enables the user to fully implement the selected function on the selected application card. This final display is the same final display which the Graphical Shelf Navigator would provide if the user had selected the application card and function using the Graphical Shelf Navigator's series of graphical displays (such as are depicted in FIGS. **4** and **5**, for example), rather than Pull-Down Menus **200** and **202**.

One example of such a display is depicted in FIG. **6**. FIG. **6** depicts such a display in the particular case where, using the pull-down menus depicted in either FIGS. **8** or **9**, the user selects the function which is designated by "Create" to be performed on the application card which is designated by "STGS". In order to implement the function designated by "Create" on the application card designated by "STGS", the user configures each of the parameters provided in Configuration Lines **176** as desired, and then invokes the "Apply" Command **178**. If, on the other hand, the user decides to not implement the function designated by "Create" on the application card designated by "STGS", the user invokes the "Dismiss" command **180**.

Although FIG. **6** depicts the Graphical Shelf Navigator's display in the particular case where the user has used Pull-Down Menus **200** and **202** to select the function designated by "Create" to be performed on the application card designated by "STGS", the Graphical Shelf Navigator provides such a display for every combination of available application cards and available functions. The visual appearance of each display, and the particular Configuration Lines **176** provided in each display, depend on the application card and the function selected by the user.

FIG. **10** depicts an exemplary process flow for the operation of the Graphical Shelf Navigator pull-down menu example depicted in FIG. **8**. As shown in Block **204**, the Graphical Shelf Navigator begins by displaying to the user the graphical display depicted in FIG. **8**. The user then selects the desired option from Menu Bar **134**. As shown in Blocks **208** and **210**, respectively, the Graphical Shelf Navigator then generates the appropriate Pull-Down Menu **200**,

and also deactivates Cabinet Graphic **120** and Icon Bar **133**. Using Pull-Down Menu **200**, the user selects the specific application card on which the user desires to perform a function, as shown in Block **212**. As shown in Block **214**, the Graphical Shelf Navigator then generates the appropriate Pull-Down Menu **202**. Using Pull-Down Menu **202**, the user then selects the function to be performed on the selected application card, as shown in Block **216**.

As shown in Block **218**, the Graphical Shelf Navigator then changes the user's display to the display depicted in FIG. **6**. As shown in Block **220**, the user appropriately configures each of the parameters provided in Configuration Lines **176**. Finally, in order to execute the selected function on the selected application card, the user invokes the "Apply" Command **178**, as shown in Block **222**.

Although the present invention and its advantages have been described in detail, it should be understood that various changes, substitutions and alterations can be made therein without departing from the spirit and scope of the invention as defined by the appended claims.

What is claimed is:

1. A telecommunications switch management system for providing access to a telecommunications switching system, comprising:

a system manager building block in communication with a remote computer:

a system management interface building block in communication with said system manager building block, said system management interface building block having a system command interface building block containing at least one client building block; and

at least one server building block in communication with said at least one client building block in said system management interface building block, said at least one server building block being in communication with the telecommunications switching system, wherein said system manager building block provides communication between said remote computer and said system management interface building block, and wherein said system management interface building block provides communication between said system manager building block and said at least one server building block, so that said remote computer is provided access to the telecommunication switching system, said remote computer operable to perform a function on a selected application card within the telecommunication switching system in response to user inputs and in response to the user having an appropriate authorization level associated with the function; and

wherein said system manager building block and said system management interface building block conform to a common object request broker architecture (CORBA), and wherein said system manager building block is configured to communicate with said system management interface building block using a CORBA communication protocol.

2. The telecommunications switch management system of claim **1**, wherein said at least one client building block in communication with said at least one server building block further comprises:

a system security manager client building block in communication with a system security manager server building block for providing the telecommunications switching system with security functions;

a bearer manager client building block in communication with a bearer manager server building block for providing an ability to perform management functions on the telecommunications switching system;

a fault manager client building block in communication with a fault manager server building block for providing an ability to review faults which have occurred in the telecommunications switching system;

a test manager client building block in communication with a test manager server building block for providing an ability to perform tests on the telecommunications switching system;

a performance manager client building block in communication with a performance manager server building block for providing an ability to review the performance of the telecommunications switching system; and

a configuration management client building block in communication with a configuration management server building block for providing an ability to configure attributes of the telecommunications switching system.

3. The telecommunications switch management system of claim **1**, wherein said system management interface building block further comprises a command interpreter building block in communication with said system manager building block, and in communication with said system command interface building block containing said at least one client building block, wherein said system manager building block provides communication between said remote computer and said command interpreter building block, and wherein said command interpreter building block provides communication between said system manager building block and said system command interface building block containing said at least one client building block.

4. The telecommunications switch management system of claim **3**, wherein said at least one client building block in communication with said at least one server building block further comprises a system security manager client building block in communication with a system security manager server building block for providing the telecommunications switching system with security functions.

5. The telecommunications switch management system of claim **3**, wherein said at least one client building block in communication with said at least one server building block further comprises a bearer manager client building block in communication with a bearer manager server building block for providing an ability to perform management functions on the telecommunications switching system.

6. The telecommunications switch management system of claim **3**, wherein said at least one client building block in communication with said at least one server building block further comprises a fault manager client building block in communication with a fault manager server building block for providing an ability to review faults which have occurred in the telecommunications switching system.

7. The telecommunications switch management system of claim **3**, wherein said at least one client building block in communication with said at least one server building block further comprises a test manager client building block in communication with a test manager server building block for providing an ability to perform tests on the telecommunications switching system.

8. The telecommunications switch management system of claim **3**, wherein said at least one client building block in communication with said at least one server building block further comprises a performance manager client building block in communication with a performance manager server building block for providing an ability to review the performance of the telecommunications switching system.

9. The telecommunications switch management system of claim 3, wherein said at least one client building block in communication with said at least one server building block further comprises a configuration management client building block in communication with a configuration management server building block for providing an ability to configure attributes of the telecommunications switching system.

10. The telecommunications switch management system of claim 1, wherein said remote computer is configured to communicate with said system manager building block using an internet inter-ORB protocol (IIOP) communications protocol.

11. The telecommunications switch management system of claim 1, wherein said remote computer is configured to communicate with said system manager building block using a hypertext transport protocol (HTTP) communications protocol.

12. The telecommunications switch management system of claim 3, wherein said system manager building block and said command interpreter building block conform to a common object request broker architecture (CORBA), and wherein said system manager building block communicates with said command interpreter building block using a CORBA communications protocol.

13. The telecommunications switch management system of claim 3, wherein said command interpreter building block is configured to communicate with said system command interface building block containing said at least one said client building block using a library application programming interface (API) communications protocol.

14. The telecommunications switch management system of claim 1, wherein said at least one client building block and said at least one server building block conform to a common object request broker architecture (COBRA), and wherein said at least one client building block is configured to communicate with said at least one server building block using a CORBA communications protocol.

15. A telecommunications switch management system for providing access to a telecommunications switching system, comprising:

a system manager building block having a CORBA architecture and being in communication with a remote computer;

a command interpreter building block having a CORBA architecture and being in communication with said system manager building block using a CORBA communications protocol;

a system command interface building block in communication with said command interpreter building block using a library application programming interface (API) communications protocol, said system command interface building block having a system security manager client building block having a CORBA architecture, a bearer manager client building block having a CORBA architecture, a fault manager client building block having a CORBA architecture, a test manager client building block having a CORBA architecture, a performance manager client building block having a CORBA architecture, and a configuration management client building block having a CORBA architecture;

a system security manager server building block having a CORBA architecture and being in communication with said system security manager client building block using a CORBA communications protocol, for providing the telecommunications switching system with security functions;

a bearer manager server building block having a CORBA architecture and being in communication with said bearer manager client building block using a CORBA communications protocol, for providing an ability to perform management functions on the telecommunications switching system;

a fault manager server building block having a CORBA architecture and being in communication with said fault manager client building block using a CORBA communications protocol, for providing an ability to review faults which have occurred in the telecommunications switching system;

a test manager server building block having a CORBA architecture and being in communication with said test manager client building block using a CORBA communications protocol, for providing an ability to perform tests on the telecommunications switching system;

a performance manager server building block having a CORBA architecture and being in communication with said performance manager client building block using a CORBA communications protocol, for providing an ability to review the performance of the telecommunications switching system; and

a configuration management server building block having a CORBA architecture and being in communication with said configuration management client building block using a CORBA communications protocol, for providing an ability to configure attributes of the telecommunications switching system, said server building blocks being in communication with the telecommunications switching system, wherein said system manager building block provides communication between said remote computer and said command interpreter building block, wherein said command interpreter building block provides communication between said system manager building block and said system command interface building block having said client building blocks, and wherein said system command interface building block having said client building blocks provides communication between said command interpreter building block and said server building blocks, so that said remote computer is provided access to the telecommunications switching system, said remote computer operable to perform a function on a selected application card within the telecommunications switching system in response to user inputs and in response to the user having an appropriate authorization level associated with the function.

16. The telecommunications switch management system of claim 15, wherein said remote computer is configured to communicate with said system manager building block using an internet inter-ORB protocol (IIOP) communications protocol.

17. The telecommunications switch management system of claim 15, wherein said remote computer is configured to communicate with said system manager building block using a hypertext transport protocol (HTTP) communications protocol.

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